(12)

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THE VISIBILITY ANALYSIS PROGRAM USER'S GUIDE

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AFAMRL-TR-81-152

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FOR THE COMMANDER

CHARLES BATES, JR.
Chief
Human Engineering Division
Air Force Aerospace Medical Research Laboratory

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This Visibility Analysis Program User's Guide describes a computer program that generates a hard copy plot of the visual angles to crew station components from the crewmember viewpoint. Using this program crew station designers can evaluate crewmember/crew station visual interaction.

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The Guide also describes a procedure to facilitate installation and use of the program at the user's facility. The procedure consists of three principle steps: installation of the program on user's computer system, digitization of crew stations, and program execution. A listing of the program is also included.

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SUMMARY

Military Standard 850B titled "Aircrew Station Vision Requirements for Military Aircraft" establishes requirements for providing adequate vision from within the aircrew stations of military aircraft. The standard requires a "total vision envelope plot" as a means of demonstrating compliance. This plot is a map of visual angles of line-of-sight to obstructions to external vision, such as the aircraft structures, window frames, and accessory equipment (fixed and retractable) which obscure vision through the transparencies (windows). The standard describes a method for constructing total vision envelope plots from information found in crew station drawings. This method is quite time consuming and not versatile because plots are made from only one viewpoint, the hypothetical Design Eye Position, which is defined in MIL-STD-1333.

In developing the AFAMRL COMBIMAN (COMputerized BIomechanical MAN-model), we have created the capability to make total vision envelope plots with several enhancements not required by MIL-STD-850. Since the plots are drawn on a computer graphics device, the objects plotted need not be limited to those obstructing vision outside the aircraft, but may include the entire crew station with all the displays and controls. Because the model is general, the crew station or workplace is not limited to an aircraft cockpit, but can be any environment, such as an automobile, a computer terminal, etc. Furthermore, the model is not limited to the Design Eye Point. Plots can be quickly made from different eye positions, head orientations, or even plots from left and right eye positions.

This plotting program has such broad application that we have removed it from the COMBIMAN program so that it will be available to almost any computer user having a graphics plotter.

Dr. Joe McDaniel
Workload and Ergonomics Branch
Air Force Aerospace Medical
Research Laboratory (AFAMRL)

PREFACE

This work was performed under USAF Contract F33615-78-C-0507 entitled, *Biomechanics of Cockpit Evaluation*. The contract monitor and technical advisor for this contract is Dr. Joe McDaniel of the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Laboratory (AFAMRL), Wright-Patterson Air Force Base.

The purpose of this report is to provide a guide to use the VISIBILITY ANALYSIS program. The VISIBILITY ANALYSIS program was developed and revised over the years by the University of Dayton Research Institute as a part of the COMputerized BIomechanical MAN-model (COMBIMAN) system of programs. The VISIBILITY ANALYSIS program is an independent program and runs separately from the COMBIMAN program.

Other methods of measuring cockpit visual angles include a Binocular Cockpit Visibility Camera developed between 1948 and 1951, primarily through the efforts of Mr. T. M. Edwards (1952). A comparison of 15 Air Force aircraft using this camera system was reported by Kennedy and McKechnie (1970).

The authors would like to acknowledge the contributions of Dr. Joe McDaniel, Dr. P. T. Bapu, Mr. Glen Potter and would like to thank Ms. Charlene Thompson for preparing the manuscript for publication.

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INTRODUCTION

During the design and analysis phases of crew station development, it is essential to assess the accommodation of the crew station environment with respect to the human operator. The COMputerized BIomechanical MAN-model (COMBIMAN) system of programs has been developed to assist in the design and analysis phases of crew station development. One of the important capabilities of the COMBIMAN system of programs is to produce plots of an aircraft crew station from the crewmember's viewpoint. To enhance the capability of certain aircraft for nighttime operation, selective shieldings are installed on certain light sources. In order to evaluate these crew stations, it is necessary to map the visual angle of incidence from each crew member to each existing and proposed light source.

The VISIBILITY ANALYSIS program (VISANS) is developed to aid crew station designers to evaluate crewmembers/crew station visual interaction. The VISANS program was developed as a part of the COMBIMAN system of programs by the University of Dayton Research Institute under USAF Contract F33615-78-C-0507 entitled "Biomechanics of Cockpit Evaluation." The VISANS program is now an independent program and runs separately from the COMBIMAN program.

The VISANS program uses the three dimensional coordinates of the eye location of the crewmember and the three dimensional coordinates of the crew station (geometrically described as panels and contours) to generate a hard copy plot of the visual angles with respect to the crewmember's line-of-sight, together with legends identifying the instruments and/or light sources (see Figure 1). Four ellipses are superimposed on the plot to define the limits of various visual fields. The inner most field, denoted by the letter S, is the field of stereo vision, visible to both eyes simultaneously. The field denoted by the letter F

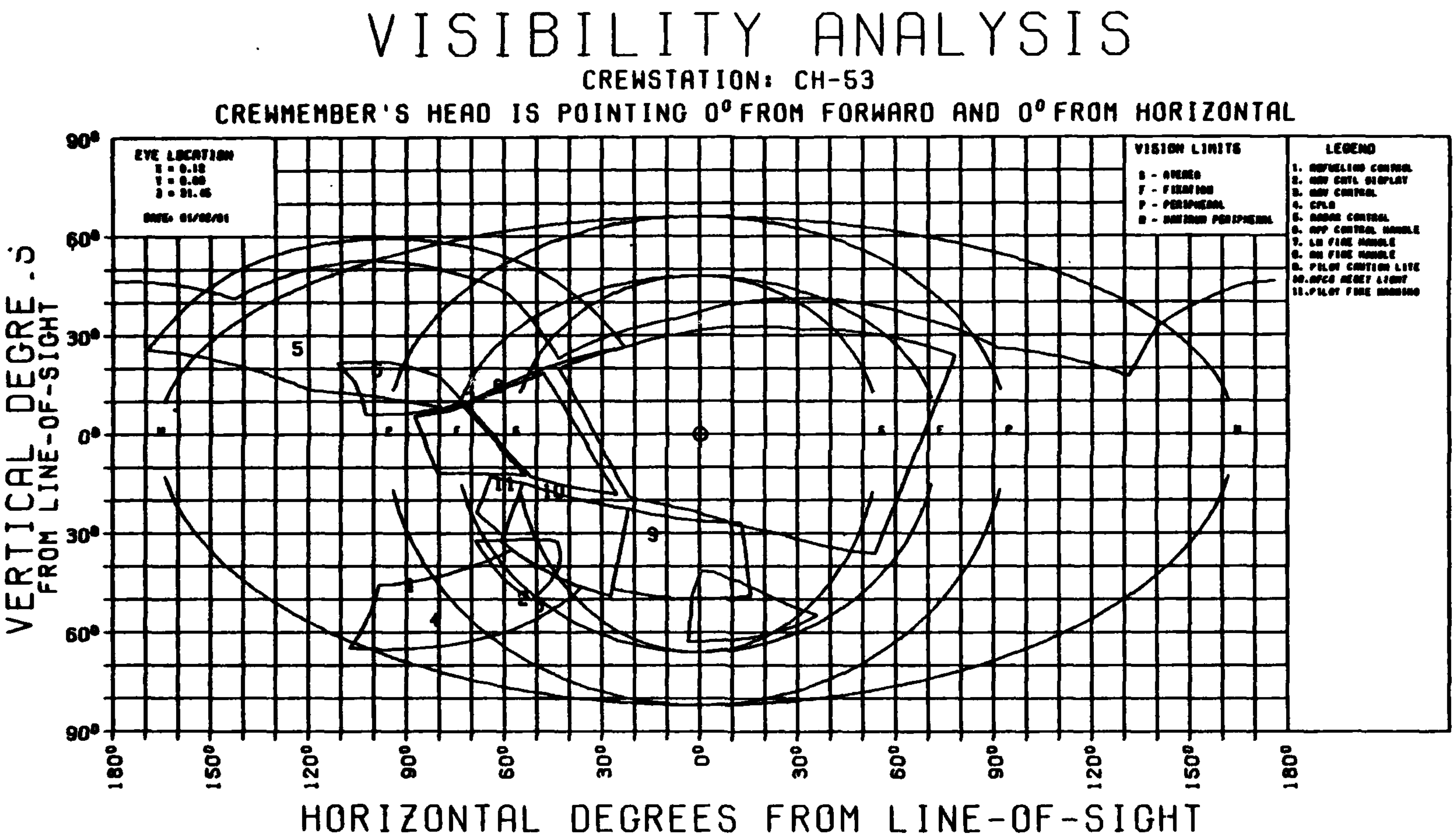


Figure 1. Example of Total Vision Envelope Plot.

is the field of fixation, that is, what the eyes can see directly without turning the head. The field denoted by the letter P is the field of peripheral vision with the eyes caged with respect to the head. The outermost field denoted by the letter M is the maximum peripheral vision limit for the extreme eye deviation. The user has the option to suppress these visual fields as explained in Section 4. In addition to generating a hard copy plot, the program calculates and prints the vision angles to each vertex of the panels and contours defining the crew station, together with the corresponding three dimensional coordinates of these vertices in the user's original coordinate system.

The panels and contours which geometrically describe the crew station may consist of 3 to 25 vertices each. These vertices must be input in consecutive order either clockwise or counterclockwise around the perimeter of each panel or contour. Miscellaneous equipment (instruments and/or light sources) consist of one vertex each, that is, a single point. Items identified with a single point location have their titles listed under the LEGEND heading as shown at the right side of the plot in Figure 1. These refer to the numbers on the plot itself. The center of the number is the exact location of the point on the plot. The coordinates of the vertices may be entered in any three dimensional system. However the user must specify the coordinates of a Seat Reference Point (SRP) with respect to the origin of the crew station coordinate system. The visibility analysis program (VISANS) converts all crew station data to a common right handed three dimensional coordinate system with the origin at the specified SRP. This conversion allows maximum flexibility for both military and nonmilitary applications.

The following procedure summary is included to facilitate installation and use of the program at the user's facility. The procedure consists of three principal steps as follows:

(1) <u>Installation of the Program on User's Computer System</u>.

Although the program is written in FORTRAN IV, the conventions for end-of-file (EOF) detection, plot initialization and termination,

as well as file handling procedures may differ from system to system and some minor modifications may be needed. In addition, the JCL and device references of Section 5 describe the procedures for a particular set of hardware and operating system (specifically a CDC 6600 computer, CDC tape drives, CALCOMP plotting hardware, and a NOS/BE operating system). It will be necessary to tailor the job control language to the user's system. A listing of the program is included in Appendix B.

(2) Digitization of Crew Stations. The workplace or crew station must be reduced to points, lines, and panels as described in Section 2 and Paragraph 4.2. These data may be stored on punched cards, magnetic tape, or disk, but must be coded for the user's specific application prior to using the program. The contents and complexity of these data depends on the user's application. In the examples in this report only the major console and window outlines are depicted along with a few control references; however, individual control panels, knobs, dials, etc., may be included if the user requires them.

(3) Program Execution. Each program run requires crew station data, an eye location, and eye orientation information. These requirements are described in detail in Paragraph 4.2. Note that it is possible to obtain many plots in a single run, each depicting a different crew station and/or eye orientation, by judicious arrangement of the input data.

SECTION 2
AN ILLUSTRATION

In order to use the Visibility Analysis Program (VISANS) the user must be able to geometrically describe the crew station to be analyzed. The example used to illustrate this procedure is based on the crew station in Figure 2 consisting of a six drawer desk. In modeling the desk, only the desk's top, front side, and leg well are defined. The other sides are not needed because they do not cause any physical or visual interference to a person sitting at a desk.

First, we arbitrarily choose an origin and define a coordinate system. In this example we chose the mid-point of the front edge of the top of the desk to be the origin and defined the coordinate system as follows:

+X Forward
+Y Left
+Z Up .

Using the dimensions of the desk, and the origin of the coordinate system, the three dimensional coordinates are obtained for the various vertices of the panels and for the location of any controls or other miscellaneous equipment as needed. Next the user must supply the program with the three dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of the crew station's coordinate system. The three dimensional coordinates of SRP with respect to the origin of the desk are defined as follows:

X-Coordinate = -15.0
Y-Coordinate = 0.0
Z-Coordinate = -11.0 .

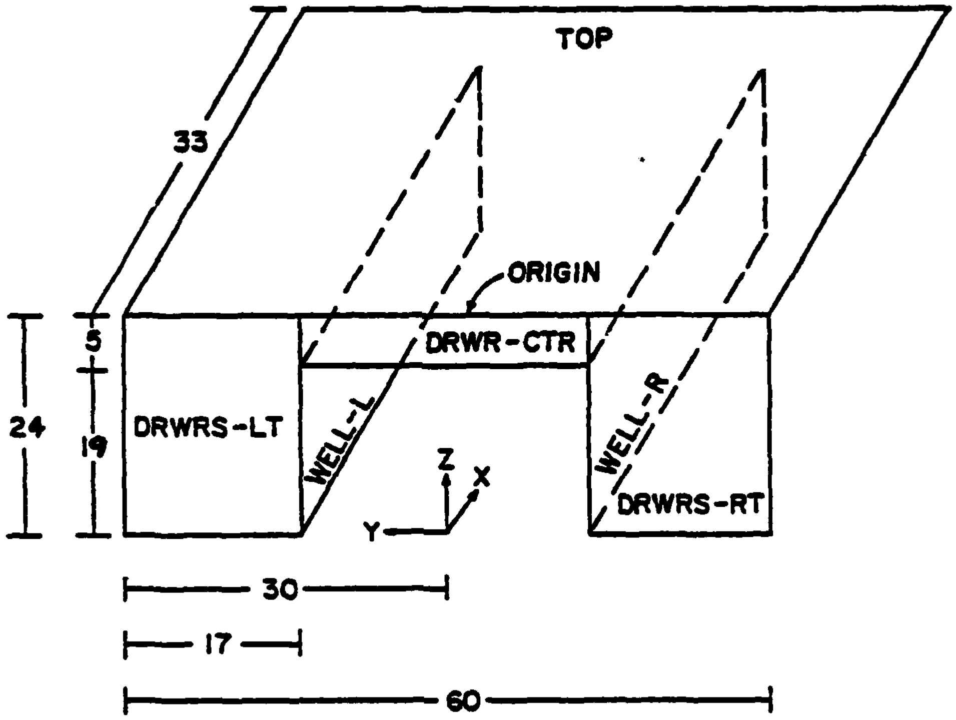


Figure 2. Sample Crew Station - DESK.

As shown in Figure 2, the "DESK" consists of a total of six panels. Each panel has four vertices, and is rectangular in shape. The coordinates of the vertices are shown in Figures 3a and 3b.

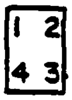
Figure 4a shows a visibility plot of the "DESK" shown in Figure 2. The eye location (X=6.12, Y=0.0, and Z=31.46) shown in this figure was arbitrarily selected, the user may enter any desired values as described in Paragraph 4.1. The user may modify or change the visual field overlays by changing the equations defining these overlays in subroutine VISPLT (see Appendix B). For this example, the crewmember (the person sitting at the desk) is looking 0° from forward and 0° from horizontal. The information provided by the visibility plot is explained in Paragraph 3.1.

Figure 4b shows the program input used to generate the visibility plot. This is explained in Section 4.

1TOP

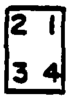
POINT	X	Y	Z
1	0.0	30.0	0.0
2	33.0	30.0	0.0
3	33.0	-30.0	0.0
4	0.0	-30.0	0.0

2DRWRS-LT



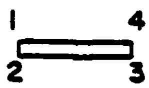
POINT	X	Y	Z
1	0.0	30.0	0.0
2	0.0	13.0	0.0
3	0.0	13.0	-24.0
4	0.0	30.0	-24.0

3DRWRS-RT



POINT	X	Y	Z
1	0.0	-30.0	0.0
2	0.0	-13.0	0.0
3	0.0	-13.0	-24.0
4	0.0	-30.0	-24.0

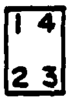
4DRWRS-CT



POINT	X	Y	Z
1	0.0	13.0	0.0
2	0.0	13.0	-5.0
3	0.0	-13.0	-5.0
4	0.0	-13.0	0.0

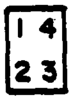
Figure 3a. X, Y, and Z Coordinates of Panels of DESK.

5WELL-LT



POINT	X	Y	Z
1	0.0	13.0	-5.0
2	0.0	13.0	-24.0
3	33.0	13.0	-24.0
4	33.0	13.0	-5.0

6WELL-RT



POINT	X	Y	Z
1	0.0	-13.0	-5.0
2	0.0	-13.0	-24.0
3	33.0	-13.0	-24.0
4	33.0	-13.0	-5.0

Figure 3b. X, Y, and Z Coordinates of Panels of DESK.

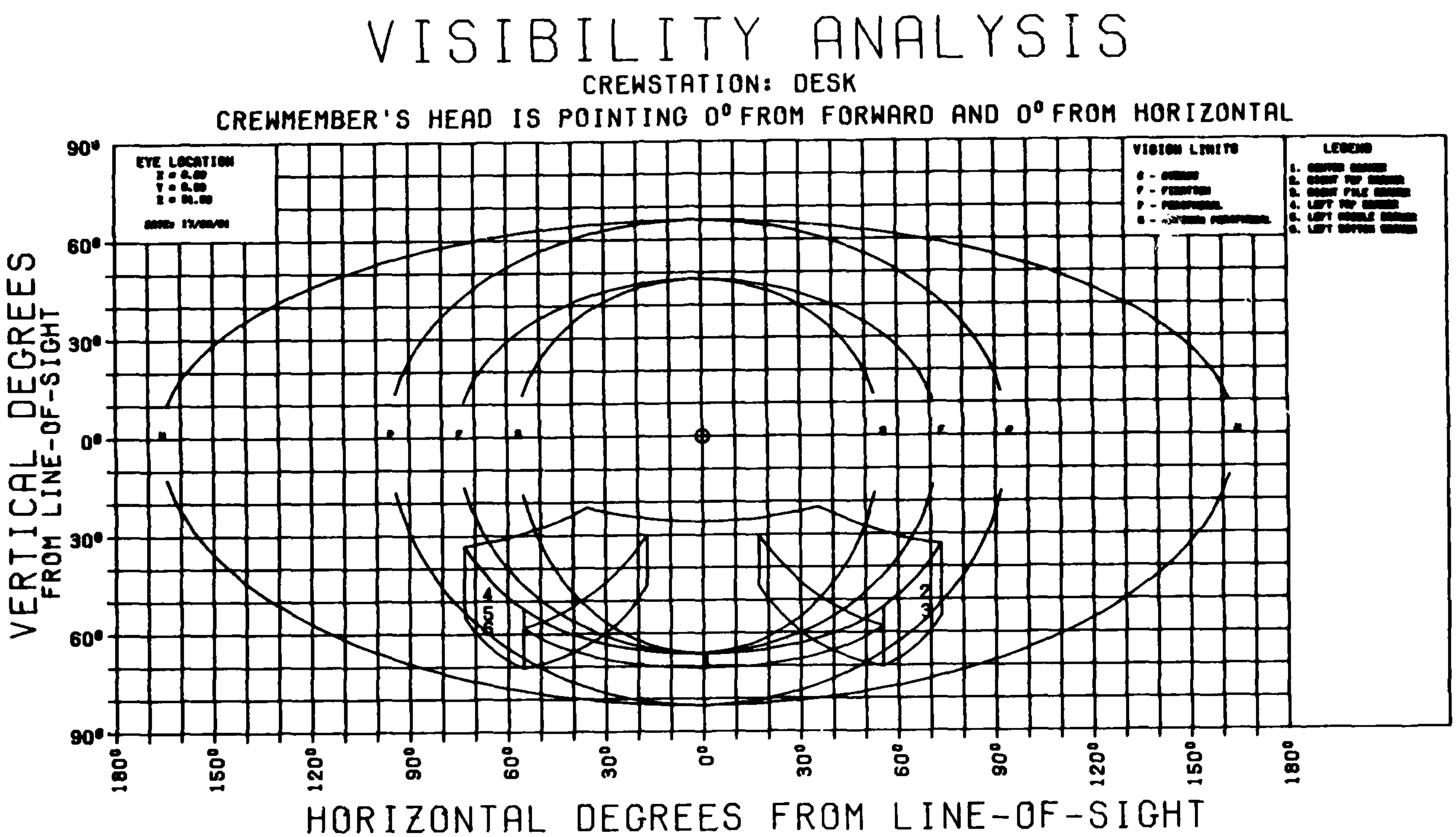


Figure 4a. Visibility Plot of the "DESK".

```
$CNTRL NEW=1  $
$ADD DESK       6 6-15.00  0.0 -11.00 F L U        17/06/81
 11TOP                          4
   0.0  30.0   0.0
  33.0  30.0   0.0
  33.0 -30.0   0.0
   0.0 -30.0   0.0
 12DRWRS-LT                     4
   0.0  30.0   0.0
   0.0  13.0   0.0
   0.0  13.0 -24.0
   0.0  30.0 -24.0
 13DRWRS-RT                     4
   0.0 -30.0   0.0
   0.0 -13.0   0.0
   0.0 -13.0 -24.0
   0.0 -30.0 -24.0
 14DRWRS-CT                     4
   0.0  13.0   0.0
   0.0  13.0  -5.0
   0.0 -13.0  -5.0
   0.0 -13.0   0.0
 15WELL-LT                      4
   0.0  13.0  -5.0
   0.0  13.0 -24.0
  33.0  13.0 -24.0
  33.0  13.0  -5.0
 16WELL-RT                      4
   0.0 -13.0  -5.0
   0.0 -13.0 -24.0
  33.0 -13.0 -24.0
  33.0 -13.0  -5.0
  1CENTER DRAWER                1
  0.00  0.00 -5.00
  2RIGHT TOP DRAWER             1
  0.00-21.50 -7.00
  3RIGHT FILE DRAWER            1
  0.00-21.50-13.50
  4LEFT TOP DRAWER              1
  0.00 21.50 -7.00
  5LEFT MIDDLE DRAWER           1
  0.00 21.50-13.50
  6LEFT BOTTOM DRAWER           1
  0.00 21.50-20.00
     6.         0.        31.5

 $CNTRL IEND=1 $
```

Figure 4b. Input Data Generating the Visibility Plot in Figure 4a.

SECTION 3
THE VISIBILITY ANALYSIS (VISANS) PROGRAM* OUTPUT

This program provides visibility data to evaluate crewmember/crew station or other crew station interactions. It allows the user to label the instruments and/or light sources (miscellaneous equipments) of a crew station and it also includes an optional overlay defining the limits of various visual fields.

3.1 THE VISIBILITY ANALYSIS OUTPUT

The program provides both printed and graphical output (hard copy plot). The graphical output is shown in Figure 4c. The plot provides the user with the following information:

(1) The eye location of the crewmember with respect to the seat reference point (SRP) of the crew station (see Paragraph 4.2).
(2) The name of the crew station.
(3) Definition of the vision limits.
(4) The vision limits themselves.
(5) A rectilinear plot of the crew station and miscellaneous equipments.
(6) A LEGEND defining the miscellaneous equipment.
(7) The orientation of the head, in degrees.*

The printed output for this program contains:

(1) An output from subroutine VISVDM containing the crew station data (Figure 5 is an example of subroutine VISVDM output - see Paragraph 4.2 for details), and
(2) An output from the main routine for each plot consisting of the Namelist CNTRL's variable values, the eye location, head orientation, and, for each vertex, its three dimensional coordinates (in the original crew station coordinate system) along with the vision angles at which that vertex can be found.

*Note that for line-of-sight angles, positive horizontal is left of forward and positive vertical is above the horizontal.

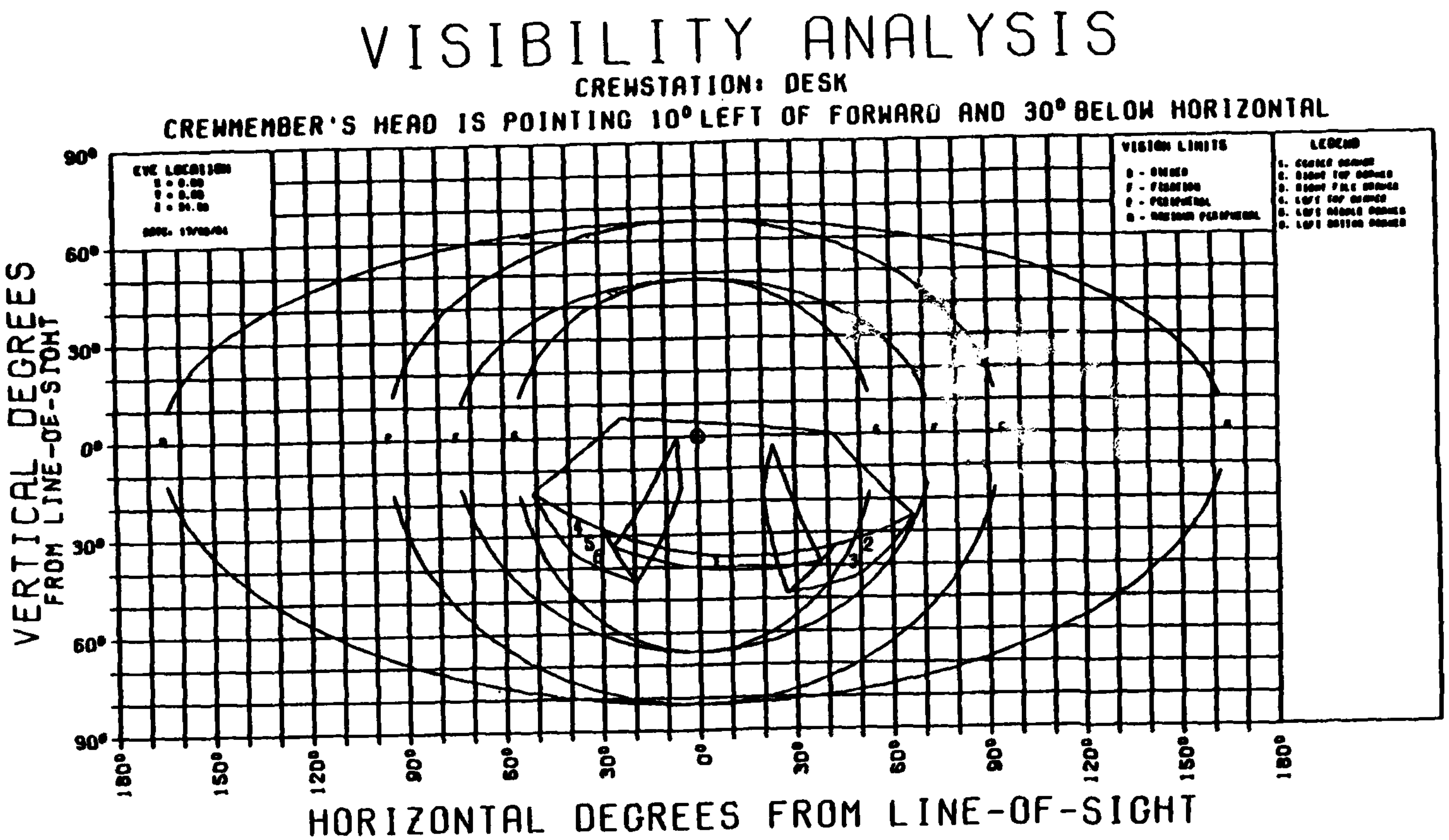


Figure 4c. The Graphical Output of the Desk. (The person sitting at the desk is look 30° down and 10° to the left.)

```
VISANS -- VISIBILITY ANALYSIS PROGRAM                                                    PAGE   1

VIS500I &ADD CH 53    12111+3.80 24.00140.70 A R U
VIS519I MEMBER, CH-53    (01/02/81), HAS  12 BOUNDARIES AND 11 MISCELANEOUS EQUIPMENTS
VIS520I COORDINATES ARE TRANSLATED TO ( 143.80,  24.00, 140.70).
VIS521I COORDINATES GIVEN AS A, R AND U ARE NOW F, L, AND U.
        1.) RSIDE                 4 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES --
                                            ( 116.25  13.25 146.73)  TO  (  27.55  10.75   6.03)
                                            ( 116.25  30.00 146.73)  TO  (  27.55  -6.00   6.03)
                                            ( 111.47  30.00 158.55)  TO  (  32.33  -6.00  17.85)
                                            ( 110.81  13.25 160.14)  TO  (  32.99  10.75  19.44)
        2.) CENTER                4 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                            ( 116.81  13.25 145.07)  TO  (  26.99  10.75   4.37)
                                            ( 110.81  13.25 160.14)  TO  (  32.99  10.75  19.44)
                                            ( 110.81 -13.25 160.14)  TO  (  32.99  37.25  19.44)
                                            ( 116.81 -13.25 145.07)  TO  (  26.99  37.25   4.37)
        3.) LSIDE                 4 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                            ( 116.25 -13.25 146.73)  TO  (  27.55  37.25   6.03)
                                            ( 110.81 -13.25 160.14)  TO  (  32.99  37.25  19.44)
                                            ( 111.47 -30.00 158.55)  TO  (  32.33  54.00  17.85)
                                            ( 116.25 -30.00 146.73)  TO  (  27.55  54.00   6.03)
        4.) OVERHEAD              4 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                            ( 126.92  19.44 178.00)  TO  (  16.88   4.56  37.30)
                                            ( 162.00  19.44 184.00)  TO  ( -18.20   4.56  43.30)
                                            ( 162.00 -19.44 184.00)  TO  ( -18.20  43.44  43.30)
                                            ( 126.92 -19.44 178.00)  TO  (  16.88  43.44  37.30)
        5.) LWRCONSL              4 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                            ( 142.38   8.75 138.22)  TO  (   1.42  15.25  -2.48)
                                            ( 116.81   8.75 145.07)  TO  (  26.99  15.25   4.37)
                                            ( 116.81  -8.75 145.07)  TO  (  26.99  32.75   4.37)
                                            ( 142.38  -8.75 138.22)  TO  (   1.42  32.75  -2.48)
       56.) WINDOW-UPPER RIGHT   10 VERTICES --INPUT COORDINATES--      -ABSOLUTE COORDINATES -
                                            ( 126.00  13.00 179.00)  TO  (  17.80  11.00  38.30)
                                            ( 131.00  13.00 184.00)  TO  (  12.80  11.00  43.30)
                                            ( 140.00  13.00 187.00)  TO  (   3.80  11.00  46.30)
                                            ( 152.00  13.00 188.00)  TO  (  -8.20  11.00  47.30)
                                            ( 152.00  27.00 187.00)  TO  (  -8.20  -3.00  46.30)
                                            ( 152.00  36.10 184.00)  TO  (  -8.20 -12.10  43.30)
                                            ( 152.00  40.30 179.00)  TO  (  -8.20 -16.30  38.30)
                                            ( 138.00  38.00 179.00)  TO  (   5.80 -14.00  38.30)
                                            ( 134.00  33.00 179.00)  TO  (   9.80  -9.00  38.30)
                                            ( 128.00  23.00 179.00)  TO  (  15.80   1.00  38.30)
       57.) WINDOW-UPPER LEFT    10 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES
                                            ( 126.00 -13.00 179.00)  TO  (  17.80  37.00  38.30)
                                            ( 131.00  13.00 184.00)  TO  (  12.80  37.00  43.30)
                                            ( 140.00 -13.00 187.00)  TO  (   3.80  37.00  46.30)
                                            ( 152.00 -13.00 188.00)  TO  (  -8.20  37.00  47.30)
                                            ( 152.00 -27.00 187.00)  TO  (  -8.20  51.00  46.30)
                                            ( 152.00  36.10 184.00)  TO  (   8.20  60.10  43.30)
                                            ( 152.00 -40.30 179.00)  TO  (  -8.20  64.30  38.30)
                                            ( 138.00 -38.00 179.00)  TO  (   5.80  62.00  38.30)
```

Figure 5. Subroutine VISVDM Printed Output.

Page 1 of 3

```
                                                  ( 134.00 -33.00 179.00)  TO  (   9.80  57.00  38.30)
                                                  ( 128.00 -23.00 179.00)  TO  (  15.80  47.00  38.30)
58 ) WINDOW-FRONT RIGHT          9 VERTICES --INPUT COORDINATES--           --ABSOLUTE COORDINATES--
                                                  ( 126.00  13.00 178.00)  TO  (  17.80  11.00  37.30)
                                                  ( 127.00  20.00 178.00)  TO  (  16.80   4.00  37.30)
                                                  ( 129.70  29.00 178.00)  TO  (  14.10  -5.00  37.30)
                                                  ( 135 00  37 00 178.00)  TO  (   8 80  13.00  37.30)
                                                  ( 127.00  36.50 159.00)  TO  (  16.80 -14.50  18.30)
                                                  ( 118 00  33.30 159.50)  TO  (  25.80  -9.30  18.80)
                                                  ( 112.00  26.10 160.00)  TO  (  31.80  -2.10  19.30)
                                                  ( 111.00  22.30 161.00)  TO  (  32.80   1.70  20.30)
                                                  ( 110.00  13.00 162.00)  TO  (  33.80  11 00  21 30)
59 ) WINDOW-FRONT MIDDLE         4 VERTICES --INPUT COORDINATES--           --ABSOLUTE COORDINATES--
                                                  ( 126.00  11.00 178.00)  TO  (  17.80  13.00  37.30)
                                                  ( 110.00  11.00 162.00)  TO  (  33.80  13.00  21.30)
                                                  ( 110.00 -11.00 162.00)  TO  (  33 80  35.00  21 30)
                                                  ( 126.00 -11.00 178.00)  TO  (  17.80  35.00  37.30)
60.) WINDOW-FRONT LEFT           9 VERTICES --INPUT COORDINATES -            -ABSOLUTE COORDINATES -
                                                  ( 126.00 -13.00 178.00)  TO  (  17.80  37.00  37.30)
                                                  ( 127.00 -20.00 178.00)  TO  (  16.80  44.00  37.30)
                                                  ( 129.70 -29.00 178.00)  TO  (  14.10  53.00  37.30)
                                                  ( 135.00 -37.00 178.00)  TO  (   8.80  61 00  37 30)
                                                  ( 127.00 -38.50 159.00)  TO  (  16.80  62.50  18.30)
                                                  ( 118.00 -33.30 159.50)  TO  (  25.80  57.30  18.80)
                                                  ( 112.00 -26.10 160.00)  TO  (  31.80  50.10  19.30)
                                                  ( 111.00 -22.30 161.00)  TO  (  32.80  46.30  20.30)
                                                  ( 110.00 -13.00 162.00)  TO  (  33.80  37.00  21 30)
61.) WINDOW-LOWER RIGHT         14 VERTICES --INPUT COORDINATES -            -ABSOLUTE COORDINATES--
                                                  (  86.50  24.70 127.00)  TO  (  57.30   -.70 -13.70)
                                                  (  87.40  27.80 127.00)  TO  (  56.40  -3.80 -13.70)
                                                  (  90.40  30.80 127.00)  TO  (  53.40  -6.80 -13.70)
                                                  (  92 90  33 80 127.00)  TO  (  50.90  -9.80 -13.70)
                                                  (  99.30  37.60 127.00)  TO  (  44.50 -13.60 -13.70)
                                                  ( 111.80  42.80 127.00)  TO  (  32.00 -18.80 -13.70)
                                                  ( 106.80  41.20 119.60)  TO  (  35.00 -17.20 -21.10)
                                                  ( 105.10  38.50 110.70)  TO  (  38.70 -14.50 -30.00)
                                                  ( 103.30  35.00 106.30)  TO  (  40.50 -11.00  34 40)
                                                  ( 101 80  28 30 102 90)  TO  (  42.00   4.30  37 80)
                                                  ( 101.50  21.80 102.10)  TO  (  42.30   2.20 -38.60)
                                                  (  93.20  21.80 108.60)  TO  (  50.60   2.20 -32.10)
                                                  (  88.60  21.80 115.30)  TO  (  55.20   2.20 -25.40)
                                                  (  86.50  23.40 122.00)  TO  (  57.30    .60 -18.70)
62.) WINDOW-LOWER LEFT          14 VERTICES --INPUT COORDINATES -            -ABSOLUTE COORDINATES -
                                                  (  86.50 -24.70 127.00)  TO  (  57.30  48.70 -13.70)
                                                  (  87.40 -27.80 127.00)  TO  (  56.40  51.80 -13.70)
                                                  (  90.40 -30.80 127.00)  TO  (  53.40  54.80 -13.70)
                                                  (  92.90 -33.80 127.00)  TO  (  50.90  57.80 -13.70)
                                                  (  99.50 -37.60 127.00)  TO  (  44.30  51 60  13 70)
                                                  ( 111 80  42 80 127 00)  TO  (  32.00  65.80  13 70)
                                                  ( 106.80 -41.20 119.60)  TO  (  35.00  65.20 -21.10)
```

Figure 5. Subroutine VISVDM Printed Output.

```
VISANS -- VISIBILITY ANALYSIS PROGRAM                                                    PAGE   3

                                                   ( 105.10 -38.50 110.70)  TO  (  38.70  62.50 -30.00)
                                                   ( 103 30  35 00 106.30)  TO  (  40.50  59.00 -34.40)
                                                   ( 101.80 -28.30 102.90)  TO  (  42.00  52.30 -37.80)
                                                   ( 101.50 -21.80 102.10)  TO  (  42.30  45.80 -38.60)
                                                   (  93.20 -21.80 108.60)  TO  (  50.60  45.80 -32.10)
                                                   (  88.60 -21.80 115.30)  TO  (  55.20  45.80 -25.40)
                                                   (  86.50 -23.40 122.00)  TO  (  57.30  47.40  18.70)
        11 ) REFUELING CONTROL        1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 137.50  -6.00 139.50)  TO  (   6.30  30.00  -1.20)
        16.) NAV CNTL DISPLAY         1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 124 50   5 00 143 00)  TO  (  19 30  19.00   2 30)
        17.) NAV CONTROL              1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 124 00   7 50 143 25)  TO  (  19.80  16.50   2.55)
        20 ) CPLR                     1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 135.00   4.00 140.00)  TO  (   8.80  20.00   -.70)
        21.) RADAR CONTROL            1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 150 00   6 00 182 00)  TO  (   6.20  18 00  41 30)
        22.) APP CONTROL HANDLE       1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 142.00   0.00 180.00)  TO  (   1.80  24.00  39.30)
        23.) LH FIRE HANDLE           1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 128.00  -5.00 177.00)  TO  (  15.80  29.00  36.30)
        24.) RH FIRE HANDLE           1 VERTICES --INPUT COORDINATES -       -ABSOLUTE COORDINATES -
                                                   ( 128.00   5.00 177.00)  TO  (  15.80  19.00  36.30)
        29 ) PILOT CAUTION LITE       1 VERTICES --INPUT COORDINATES -      --ABSOLUTE COORDINATES--
                                                   ( 116.80  18.00 158.00)  TO  (  27.80   6.00  17.30)
        30.) AFCS RESET LIGHT         1 VERTICES --INPUT COORDINATES--      --ABSOLUTE COORDINATES--
                                                   ( 116.00   0.00 161.00)  TO  (  27.80  24.00  20 30)
        31.) PILOT FIRE WARNING       1 VERTICES --INPUT COORDINATES -       -ABSOLUTE COORDINATES -
                                                   ( 116.00 -18.00 158.00)  TO  (  27.80  42.80  17.30)
VIS534I CH-53    WITH   12 BOUNDARIES AND 11 MISCELANEOUS EQUIPMENTS HAS BEEN ADDED.
```

Figure 5. Subroutine VISVDM Printed Output.

Figure 6 is a sample of the main routine output and contains the following:

(1) The program name.

(2) The page number.

(3) The visibility member name and the date created.

(4) The eye location.

(5) The head orientation.

(6) Each visibility contour, panel, and/or point source name.

(7) Cross reference output showing the vision angles for each vertex of the visibility member.

```
VISANS -- VISIBILITY ANALYSIS PROGRAM  1                                        PAGE   4  2

                          VISIBILITY MEMBER NAME CH-53     (01/02/81)  3

                          EYE LOCATION IN SRP SYSTEM  (  6.12,   0.00,  31.45)  4

                          LINE-OF-SIGHT IN DEGREES      (    0,     0)  5

                          VISIBILITY PLOT DATA FOR: RSIDE  6

      LINE OF SIGHT ANGLES        ORIGINAL COORDINATES
        HORIZ.    VERT.             A          R          U     7

          27       -47           116.250    13.250    146.730
         -16       -49           116.250    30.000    146.730
         -13       -27           111.470    30.000    158.550
          22       -23           110.810    13.250    160.140

                          VISIBILITY PLOT DATA FOR: CENTER

      LINE-OF-SIGHT ANGLES        ORIGINAL COORDINATES
        HORIZ.    VERT.             A          R          U

          27       -49           116.810    13.250    145.070
          22       -23           110.810    13.250    160.140
          54       -15           110.810   -13.250    160.140
          61       -32           116.810   -13.250    145.070

                          VISIBILITY PLOT DATA FOR: LSIDE

      LINE OF SIGHT ANGLES        ORIGINAL COORDINATES
        HORIZ.    VERT.             A          R          U

          60       -31           116.250   -13.250    146.730
          54       -15           110.810   -13.250    160.140
          64       -13           111.470   -30.000    158.550
          68       -24           116.250   -30.000    146.730

                          VISIBILITY PLOT DATA FOR: OVERHEAD

      LINE-OF-SIGHT ANGLES        ORIGINAL COORDINATES
        HORIZ.    VERT.             A          R          U

          23        27           126.920    19.440    178.000
         169        26           162.000    19.440    184.000
         119        13           162.000   -19.440    184.000
          76         7           126.920   -19.440    178.000
```

Figure 6. Sample of Main Routine Printed Output. For line-of-sight angles, positive horizontal is left of forward, positive vertical is above the horizontal.

SECTION 4
INPUT TO VISANS PROGRAM

The input for program VISANS is of three types:

(1) input/output control,

(2) crew station data, and

(2) eye/head positional data.

The data stream is entered in the following form:

- the namelist CNTRL,
- crew station data,
- coordinates of the eye position, and
- coordinates of the point at which the head is pointing or the vertical and horizontal angular offsets of the head with respect to straightforward.

As many sets of input as desired may be entered ending with:

- the namelist CNTRL with IEND=1.

The general deck layout is shown in Figure 7. The following three paragraphs describe the format and content of the data input.

4.1 THE NAMELIST CNTRL

Input/output control for VISANS is accomplished using the namelist CNTRL. The namelist CNTRL and its default values are:

- NEW - if NEW is set equal to 1, VISVDM is called to read crew station data from Unit 3* in card image format as described in Paragraph 4.2 (default:0). If NEW=0, VISVDM is bypassed and the data is read from Unit 9.** (This is the case after the first plot when more than one plot of the same crew station are requested).

*Unit 3 is defined by the user and contains the input data.
**Unit 9 is where the reformatted data is written for use by program.

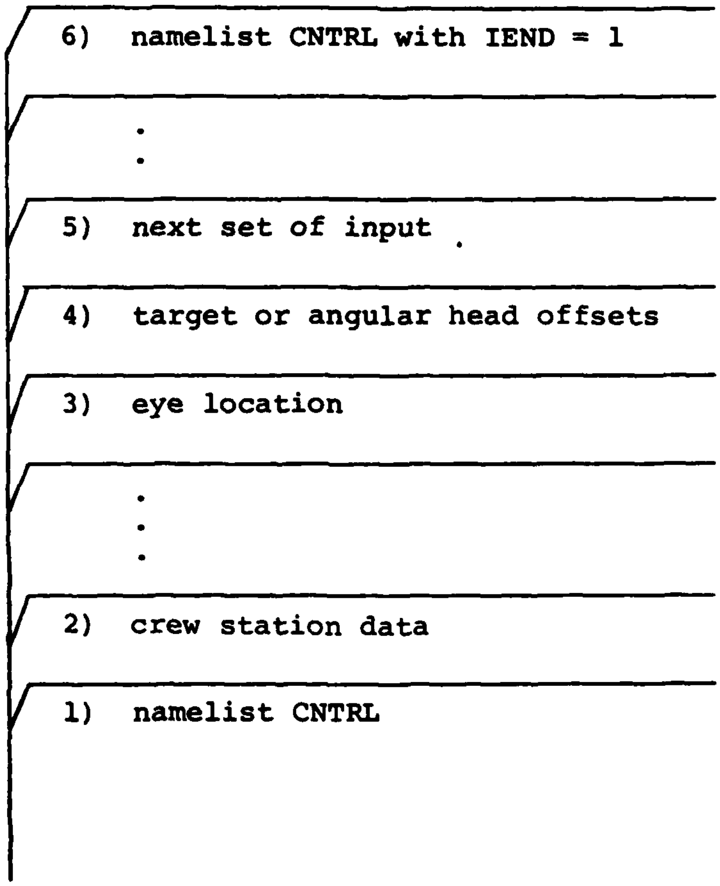


Figure 7. General Input Deck Layout.

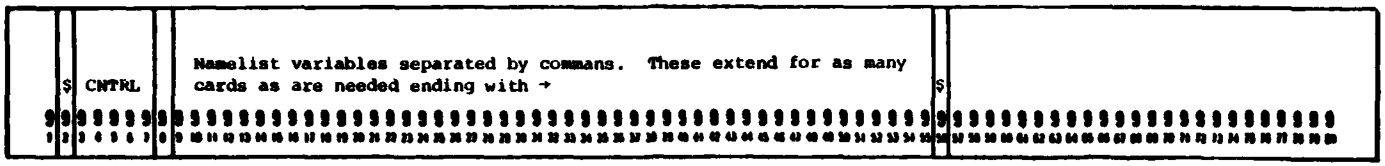
- EYELOC - if EYELOC is set equal to 1, the eye location is read from Unit 3*, otherwise the EYELOC used on the previous plot is used. If this is the first plot and EYELOC=0, the Design Eye Position (described in MIL-STD-1333) for a 13° seat back angle (6.07, 0.0, 31.5) is used (default:0).
- TARG - if TARG is set equal to zero, horizontal and vertical angle offsets for the line-of-sight are read from UNIT 3. If TARG=1, the program looks for the three dimensional coordinates of the point at which the eye is looking. (The coordinates are read from Unit 3.*) (default:0).
- ILIM - if ILIM is set equal to 1, the vision limits are superimposed on the visibility plot. If ILIM=0, no vision limits are plotted. (default:1).
- IEND - IEND set equal to 1 denotes the end of the input data. If IEND=0, the program looks for more data on Unit 3. (default:0).

The format of the namelist CNTRL is as follows (see Figure 8a):

- column 1 a blank
- column 2 a dollar sign($)**
- column 3-7 the word CNTRL
- column 8 a blank.

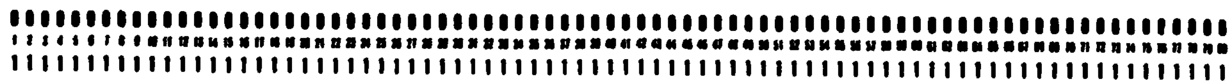
After column 8 the user may code none, all or any combinations of the control variables in the form NEW=1, EYELOC=1, ..., the last one followed by a $ sign. Note that, although embedded blanks are acceptable, on some machines they will be considered as zeros when they occur between a variable value and the following comma. Thus, a namelist string of the form NEW=1, EYELOC=1, IEND=1$ might be interpreted as NEW=1, EYELOC=10, and IEND=1.

*Unit 3 is defined by the user and contains the input data.
**Note that the format of the Namelist convention is highly machine dependent.



(a) The Namelist CNTRL Format.

```
$CNTRL NEW=1,EYELOC=1,TARG=0,ILIM=1,IEND=0$
```



(b) Namelist CNTRL Example.

Figure 8. The Namelist CNTRL Input, Highly Machine Dependent.

Figure 8b is the namelist CNTRL input that contributed to Figure 2 as follows:

- NEW=1 caused VISVDM to be called to read the CH-53 data from Unit 3.
- EYELØC=1 therefore, eye location was read as X=6.12, Y=0.0, Z=31.45.
- TARG=0 therefore, the vertical and horizontal angle offsets were read as VANG=0° and HANG=0°, i.e. head is pointing straightforward.
- ILIM=1 therefore, the vision limits are overlayed onto the visibility plot.
- IEND=0 indicating that this is not the end of the input data.

4.2 ENTERING CREW STATION DATA

Crew station data are entered with coordinates in a user defined coordinate system (see Section 2). Data may be entered as boundary definitions (panels or visibility contours) consisting of three to twenty-five vertices, or single point miscellaneous equipment to be labeled and identified on the plot legend. A combined total of 100 boundary definitions and miscellaneous equipment is allowed with no more than 40 miscellaneous equipment. The data flow is shown in Figure 9.

(1) The $ADD card containing

columns 1-4	$ADD
column 5	blank
columns 6-13	crew station member name
columns 14-16	the number of visibility boundary definitions for this member (NBNDS)
columns 17-18	the number of miscellaneous equipment for this member (NEQPTS)
columns 19-24	the neutral seat reference point (NSRP) X-coordinate (ACXYZ(1))*
columns 25-30	the NSRP Y-coordinate (ACXYZ(2))*
columns 31-36	the NSRP Z-coordinate (ACXYZ(3))*
column 37	blank

*Note that the coordinates of the NSRP are in the user's defined coordinate system.

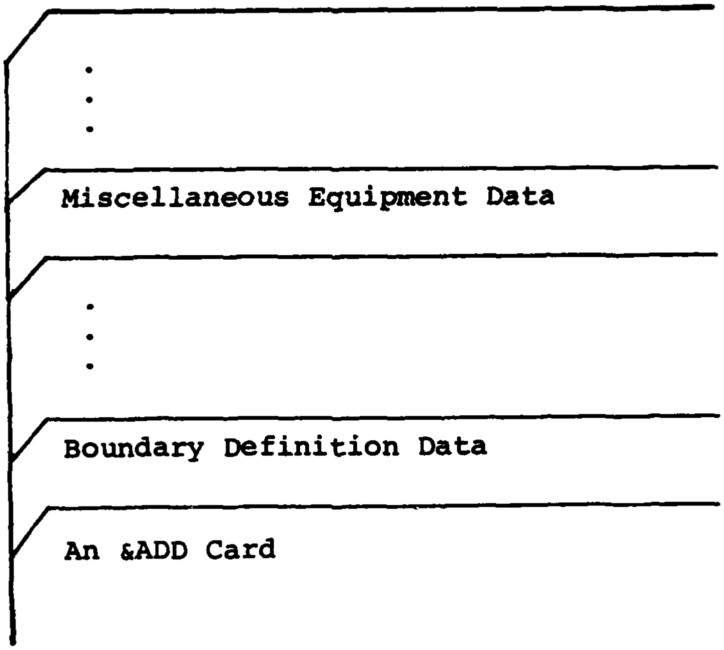


Figure 9. Crew Station Data Flow.

column	38	the direction of the positive x-axis of the input coordinate system (IX), with respect to the operator, as follows: F for Forward A for Aft L for Left R for Right U for Up D for Down
column	39	blank
column	40	the direction of the positive y-axis defined as above (IY)
column	41	blank
column	42	the direction of the positive z-axis defined as above (IZ)

(2) The NBNDS boundary definitions as follows:

Card 1	columns	1-3	sequence number for this boundary (BNØ)
	columns	4-27	the boundary name (BNAME)
	columns	28-29	blank
	columns	30-32	the number of vertices for this boundary (BNV)

This is followed by BNV cards with the coordinates for each vertex as follows:

columns	1-6	the X-coordinate in the input coordinate system*
columns	7-12	the Y-coordinate for this vertex
columns	13-18	the Z-coordinate for this vertex

(3) The NEQPTS miscellaneous equipment definitions as follows:

Card 1	columns	1-3	a sequence number (BNØ)
	columns	4-27	the name for this point to be placed in the legend (BNAME)
	column	32	a 1
Card 2	columns	1-6	the X-coordinate for this point in the input coordinate system
	columns	7-12	the Y-coordinate for this point
	columns	13-18	the Z-coordinate for this point

---

*Note that if a decimal point is not included for any coordinate, one is assumed to be between the second last and third to the last columns of each field (F6.2).

Figure 10 shows input for the Air Force's PAVLØ aircraft which contributed to the plot in Figure 1. Figure 11 shows the printed output generated by VISVDM. The first line shows the $ADD card as read by the program.

```
$ADD CH-53  121143.8  524143.80  24.00140.70 A R U
```

The second output line gives the member name, creation date, number of boundaries, and number of miscellaneous equipment, as read from the $ADD card.

```
MEMBER,CH-53 PAVLO  (01/02/81), HAS 12 BOUNDARIES AND 11 MISCELLANEOUS EQUIPMENT
```

The third line shows the X, Y, and Z coordinate offsets used to translate the new station to the programs coordinate system with the origin at the NSRP.

```
COORDINATES ARE TRANSLATED TO (143.80, 24.00, 140.70).
```

The next line describes the direction changes in the coordinate system as follows:

```
COORDINATES GIVEN AS A, R AND U ARE NOW F, L, AND U.
```

<u>Input</u>	<u>Absolute</u>
+ x - <u>A</u>ft (Fuselage Station)	+ x - <u>F</u>orward
+ y - <u>R</u>ight (Butt Line)	+ y - <u>L</u>eft
+ z - <u>U</u>p (Waterline)	+ z - <u>U</u>p

The remaining VISVDM printed output includes, for each boundary and miscellaneous equipment, the sequence number, the number of vertices, and the coordinates of each vertex both before and after translation. The last line starting with VIS534I is a message which indicates that VISVDM has successfully completed processing the visibility member.

```
 $CNTRL NEW=1  $
&ADD CH-53    12111 3.8 24.0  140.7  A R U          01/02/81
  1RSIDE                       1  4
116.25 13.25146.73
116.25  30.00146.73
111.47 30.00158.55
110.81 13.25160.14
  2CENTER                      1  4
116.81 13.25145.07
110.81 13.25160.14
110.81-13.25160.14
116.81-13.25145.07
  3LSIDE                       1  4
116.25-13.25146.73                        Boundary
110.81-13.25160.14                        Data
111.47-30.00158.55
116.25-30.00146.73
  4OVERHEAD                    1  4
126.92 19.44178.00
152.00 19.44184.00
162.00-19.44184.00
125.92-19.44178.00
  5LWRCONSL                    1  4
1-2.38  8.75138.22
116 81  8 75145 07
116.81 -8.75145.07
1-2.38 -8.75138.22

 11REFUELING CONTROL           8  1
137 50 -6 00139.50
 16NAV CNTL DISPLAY            8  1
124.50  5.00143.00
 17NAV CONTROL                 8  1
124.00  7.50143.25
 20CPLR                        8  1
135 00  4 00140 00
 21RADAR CONTROL               8  1
150.00  6.00182.00
 22APP CONTROL HANDLE          8  1
142.00  0.0 180.00                        Miscellaneous
 23LH FIRE HANDLE              8  1       Equipments
128 00 -5 00177.00
 24RH FIRE HANDLE              8  1
128.00  5.00177.00
 29PILOT CAUTION LITE          8  1
116.00 18.00158.00
 30AFCS RESET LIGHT            8  1
116 00  0 0 161.00
 31PILOT FIRE WARNING          8  1
116.00-18.00158.00
      6.12                  31 45

 $CNTRL IEND=1 $
```

Figure 10. CH-53 Aircraft Input.

```
VISANS -- VISIBILITY ANALYSIS PROGRAM                                                              PAGE    1

VIS500I &ADD CH 53     121114 3.80 24.00140.70 A R U
VIS519I MEMBER, CH-53     (01/02/81), HAS  12 BOUNDARIES AND 11 MISCELANEOUS EQUIPMENTS
VIS520I COORDINATES ARE TRANSLATED TO ( 143.80,  24.00, 140.70).
VIS521I COORDINATES GIVEN AS A, R AND U ARE NOW F, L, AND U.
          1.) RSIDE                       4 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES -
                                                     ( 116.25  13.25 146.73)  TO  (  27.55  10.75   6.03)
                                                     ( 116.25  30.00 146.73)  TO  (  27.55  -6.00   6.03)
                                                     ( 111.47  30.00 158.55)  TO  (  32.33  -6.00  17.85)
                                                     ( 110.81  13.25 160.14)  TO  (  32.99  10.75  19.44)
          2.) CENTER                      4 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES--
                                                     ( 116 81  13 25 145.07)  TO  (  26.99  10.75   4 37)
                                                     ( 110.81  13.25 160.14)  TO  (  32.99  10.75  19.44)
                                                     ( 110.81 -13.25 160.14)  TO  (  32.99  37.25  19.44)
                                                     ( 116.81 -13.25 145.07)  TO  (  26.99  37.25   4.37)
          3 ) LSIDE                       4 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES--
                                                     ( 116.25 -13.25 146.73)  TO  (  27.55  37 25   6 03)
                                                     ( 110.81 -13.25 160.14)  TO  (  32.99  37.25  19.44)
                                                     ( 111.47 -30.00 158.55)  TO  (  32.33  54.00  17.85)
                                                     ( 116.25 -30.00 146.73)  TO  (  27.55  54.00   6.03)
          4.) OVERHEAD                    4 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES--
                                                     ( 126 92  19 44 178.00)  TO  (  16.88   4.56  37.30)
                                                     ( 162.00  19.44 184.00)  TO  ( -18.20   4.56  43.30)
                                                     ( 162.00 -19.44 184.00)  TO  ( -18.20  43.44  43.30)
                                                     ( 126.92 -19.44 178.00)  TO  (  16.88  43.44  37.30)
          5.) LWRCONSL                    4 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES--
                                                     ( 142 38   8 75 138.22)  TO  (   1.42  15.25  -2.48)
                                                     ( 116.81   8.75 145.07)  TO  (  26.99  15.25   4.37)
                                                     ( 116.81  -8.75 145.07)  TO  (  26.99  32.75   4.37)
                                                     ( 142.38  -8.75 138.22)  TO  (   1.42  32.75  -2.48)
         56.) WINDOW-UPPER RIGHT         10 VERTICES --INPUT COORDINATES--        -ABSOLUTE COORDINATES -
                                                     ( 126.00  13.00 179.00)  TO  (  17.80  11.00  38.30)
                                                     ( 131 00  13 00 184.00)  TO  (  12.80  11.00  43 30)
                                                     ( 140.00  13.00 187.00)  TO  (   3.80  11.00  46.30)
                                                     ( 152.00  13.00 188.00)  TO  (  -8.20  11.00  47.30)
                                                     ( 152.00  27.00 187.00)  TO  (  -8.20  -3.00  46.30)
                                                     ( 152.00  36.10 184.00)  TO  (  -8.20 -12.10  43.30)
                                                     ( 152.00  40.30 179.00)  TO  (  -8.20 -16.30  38.30)
                                                     ( 138.00  38.00 179.00)  TO  (   5.80 -14.00  38.30)
                                                     ( 134.00  33.00 179.00)  TO  (   9.80  -9.00  38.30)
                                                     ( 128.00  23.00 179.00)  TO  (  15.80   1.00  38.30)
         57.) WINDOW-UPPER LEFT          10 VERTICES --INPUT COORDINATES--       --ABSOLUTE COORDINATES
                                                     ( 126.00 -13.00 179.00)  TO  (  17.80  37.00  38.30)
                                                     ( 131.00  13 00 184.00)  TO  (  12.80  37 00  43 30)
                                                     ( 140.00 -13.00 187.00)  TO  (   3.80  37.00  46.30)
                                                     ( 152.00 -13.00 188.00)  TO  (  -8.20  37.00  47.30)
                                                     ( 152.00 -27.00 187.00)  TO  (  -8.20  51.00  46.30)
                                                     ( 152 00  36 10 184.00)  TO  (   8 20  60.10  43.30)
                                                     ( 152 00 -40.30 179.00)  TO  (  -8.20  64.30  38.30)
                                                     ( 138.00 -38.00 179.00)  TO  (   5.80  62.00  38.30)
```

Figure 11. Subroutine VISVDM Output.

Page 1 of 3

```
                                              ( 134.00 -33.00 179.00)  TO  (   9.80  57.00  38.30)
                                              ( 128.00 -23.00 179.00)  TO  (  15.80  47.00  38.30)
      58 ) WINDOW-FRONT RIGHT        9 VERTICES --INPUT COORDINATES--     --ABSOLUTE COORDINATES--
                                              ( 126.00  13.00 178.00)  TO  (  17.80  11.00  37.30)
                                              ( 127.00  20.00 178.00)  TO  (  16.80   4.00  37.30)
                                              ( 129.70  29.00 178.00)  TO  (  14.10  -5.00  37.30)
                                              ( 135 00  37.00 178.00)  TO  (   8 80  13.00  37.30)
                                              ( 127.00  36.50 159.00)  TO  (  16.80 -14.50  18.30)
                                              ( 118 00  33.30 159.50)  TO  (  25.80  -9.30  18.80)
                                              ( 112.00  26.10 160.00)  TO  (  31.80  -2.10  19.30)
                                              ( 111.00  22.30 161.00)  TO  (  32.80   1.70  20.30)
                                              ( 110.00  13.00 162.00)  TO  (  33.80  11 00  21 30)
      59 ) WINDOW-FRONT MIDDLE       4 VERTICES --INPUT COORDINATES--     --ABSOLUTE COORDINATES--
                                              ( 126.00  11.00 178.00)  TO  (  17.80  13.00  37.30)
                                              ( 110.00  11.00 162.00)  TO  (  33.80  13.00  21.30)
                                              ( 110.00 -11.00 162.00)  TO  (  33 80  35.00  21 30)
                                              ( 126.00 -11.00 178.00)  TO  (  17.80  35.00  37.30)
      60.) WINDOW-FRONT LEFT         9 VERTICES --INPUT COORDINATES -      -ABSOLUTE COORDINATES -
                                              ( 126.00 -13.00 178.00)  TO  (  17.80  37.00  37.30)
                                              ( 127.00 -20.00 178.00)  TO  (  16.80  44.00  37.30)
                                              ( 129.70 -29.00 178.00)  TO  (  14.10  53.00  37.30)
                                              ( 135.00 -37.00 178.00)  TO  (   8.80  61 00  37 30)
                                              ( 127.00 -38.50 159.00)  TO  (  16.80  62.50  18.30)
                                              ( 118.00 -33.30 159.50)  TO  (  25.80  57.30  18.80)
                                              ( 112.00 -26.10 160.00)  TO  (  31.80  50.10  19.30)
                                              ( 111.00 -22.30 161.00)  TO  (  32.80  46.30  20.30)
                                              ( 110.00 -13.00 162.00)  TO  (  33.80  37.00  21 30)
      61.) WINDOW-LOWER RIGHT       14 VERTICES --INPUT COORDINATES -      -ABSOLUTE COORDINATES--
                                              (  86.50  24.70 127.00)  TO  (  57.30   -.70 -13.70)
                                              (  87.40  27.80 127.00)  TO  (  56.40  -3.80 -13.70)
                                              (  90.40  30.80 127.00)  TO  (  53.40  -6.80 -13.70)
                                              (  92 90  33 80 127.00)  TO  (  50.90  -9.80 -13.70)
                                              (  99.30  37.60 127.00)  TO  (  44.50 -13.60 -13.70)
                                              ( 111 80  42.80 127.00)  TO  (  32.00 -18.80 -13.70)
                                              ( 108.80  41.20 119.60)  TO  (  35.00 -17.20 -21.10)
                                              ( 105.10  38.50 110.70)  TO  (  38.70 -14.50 -30.00)
                                              ( 103.30  35.00 106.30)  TO  (  40.50 -11.00  34 40)
                                              ( 101 80  28 30 102 90)  TO  (  42.00   4.30  37 80)
                                              ( 101.50  21.80 102.10)  TO  (  42.30   2.20 -38.60)
                                              (  93.20  21.80 108.60)  TO  (  50.60   2.20 -32.10)
                                              (  88.60  21.80 115.30)  TO  (  55.20   2.20 -25.40)
                                              (  86.50  23.40 122.00)  TO  (  57.30    .60 -18.70)
      62.) WINDOW-LOWER LEFT        14 VERTICES --INPUT COORDINATES -      -ABSOLUTE COORDINATES -
                                              (  86.50 -24.70 127.00)  TO  (  57.30  48.70 -13.70)
                                              (  87.40 -27.80 127.00)  TO  (  56.40  51.80 -13.70)
                                              (  90.40 -30.80 127.00)  TO  (  53.40  54.80 -13.70)
                                              (  92.90 -33.80 127.00)  TO  (  50.90  57.80 -13.70)
                                              (  99.30 -37.60 127.00)  TO  (  44.30  61 60  13 70)
                                              ( 111 80  42 80 127.00)  TO  (  32.00  65.80  13 70)
                                              ( 108.80 -41.20 119.60)  TO  (  35.00  65.20 -21.10)
```

Figure 11. Subroutine VISVDM Output.

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```
VISANS -- VISIBILITY ANALYSIS PROGRAM                                                    PAGE   3

                                                   ( 105.10 -38.50 110.70)  TO  (  38.70  62.50 -30.00)
                                                   ( 103.30  35.00 106.30)  TO  (  40.50  59.00 -34.40)
                                                   ( 101.80 -28.30 102.90)  TO  (  42.00  52.30 -37.80)
                                                   ( 101.50 -21.80 102.10)  TO  (  42.30  45.80 -38.60)
                                                   (  93.20 -21.60 108.60)  TO  (  50.60  45.80 -32.10)
                                                   (  86.60 -21.80 115.30)  TO  (  55.20  45.80 -25.40)
                                                   (  86.50 -23.40 122.00)  TO  (  57.30  47.40  18.70)
          11 ) REFUELING CONTROL        1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 137.50  -6.00 139.50)  TO  (   6.30  30.00  -1.20)
          16.) NAV CNTL DISPLAY         1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 124.50   5.00 143.00)  TO  (  19.30  19.00   2.30)
          17.) NAV CONTROL              1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 124.00   7.50 143.25)  TO  (  19.80  16.50   2.55)
          20 ) CPLR                     1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 135.00   4.00 140.00)  TO  (   8.80  20.00   -.70)
          21.) RADAR CONTROL            1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 150.00   6.00 182.00)  TO  (   6.20  18.00  41.30)
          22.) APP CONTROL HANDLE       1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 142.00   0.00 180.00)  TO  (   1.80  24.00  39.30)
          23.) LH FIRE HANDLE           1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 128.00  -5.00 177.00)  TO  (  15.60  29.00  36.30)
          24.) RH FIRE HANDLE           1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 128.00   5.00 177.00)  TO  (  15.60  19.00  36.30)
          29 ) PILOT CAUTION LITE       1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 116.00  18.00 158.00)  TO  (  27.60   6.00  17.30)
          30.) AFCS RESET LIGHT         1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 116.00   0.00 161.00)  TO  (  27.80  24.00  20.30)
          31.) PILOT FIRE WARNING       1 VERTICES --INPUT COORDINATES--        --ABSOLUTE COORDINATES--
                                                   ( 116.00 -18.00 158.00)  TO  (  27.80  42.00  17.30)
VIS334I CH-53     WITH   12 BOUNDARIES AND 11 MISCELANEOUS EQUIPMENTS HAS BEEN ADDED.
```

Figure 11. Subroutine VISVDM Output.

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The remaining VISVDM printed output includes, for each boundary and miscellaneous equipment, the sequence number, the number of vertices, and the coordinates of each vertex both before and after translation. The last line starting with VIS534I is a message which indicates that VISVDM has successfully completed processing the visibility member.

4.3 EYE POSITIONAL DATA

The eye positional data consist of an (X, Y, Z) coordinate triplet that describes the eye location with respect to the origin of the visibility member data, and the line-of-sight information in the form of a target point for the head (X, Y, Z) or the vertical and horizontal angular offsets for the head (HANG, VANG)*.

The eye location is entered in the following format (see Figure 12a):

- columns 1-10 the X-coordinate of the eye,
- columns 11-20 the Y-coordinate of the eye,
- columns 21-30 the Z-coordinate of the eye.

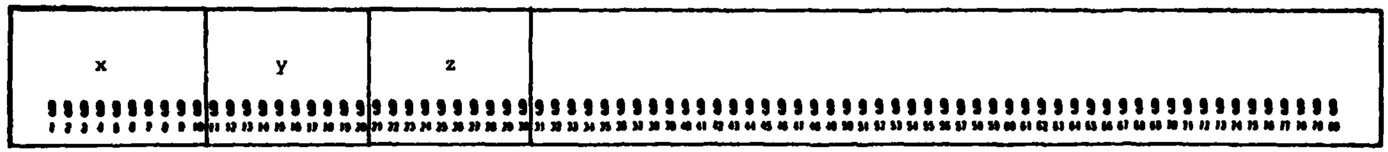
This should be entered in the SRP system (i.e. (0,0,0)=seat reference point, and axes FLU). Note that if a decimal point is not punched in the field, it is assumed to be between the second and third to the last columns in each field. Thus, the input card of Figure 12b gives the eye location X=6.12, Y=0.00, Z=31.45 for the plot of Figure 4.

To enter target data (point at which the head is pointing), enter an (X, Y, Z) coordinate triplet as follows (see Figure 13a):

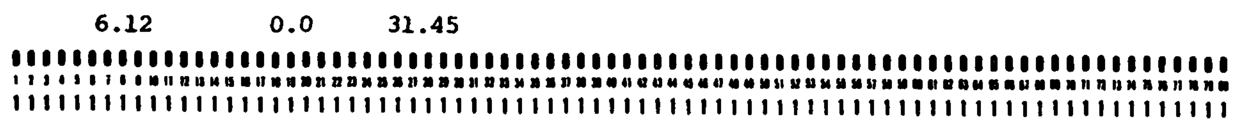
- columns 1-10 X-coordinate of head target (F10.2)
- columns 11-20 Y-coordinate of head target (F10.2)
- columns 21-30 Z-coordinate of head target (F10.2).

This should be entered in the user's coordinate system. Figure 13b shows input for the point X=16.12, Y=0.0, and Z=21.45. The user may use any desired values). Horizontal and vertical offsets to line-of-sight are entered as follows

*Note that the head position is specified by entering either target data or angular offsets, but not both.

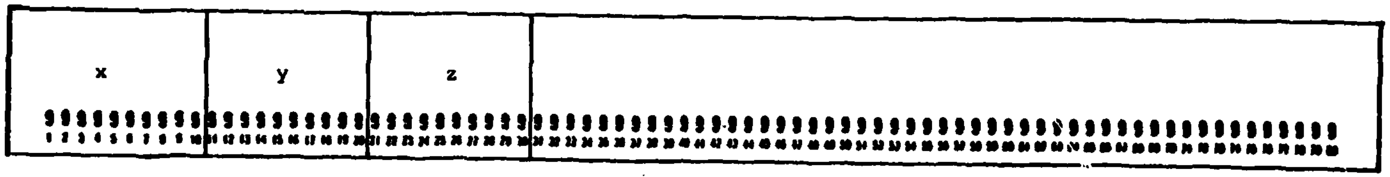


(a) The Eye Location Input Format.

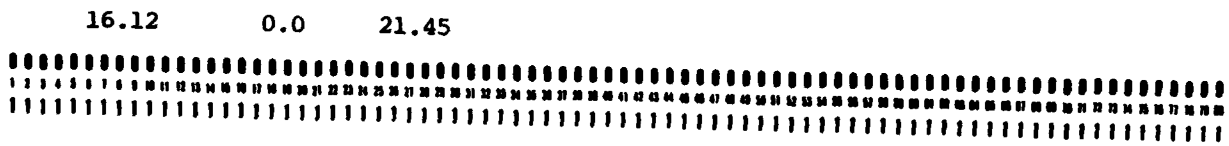


(b) An Eye Location Input Example.

Figure 12. The Eye Location Input.



(a) The Target Point Input Format.



(b) A Target Point Input Example.

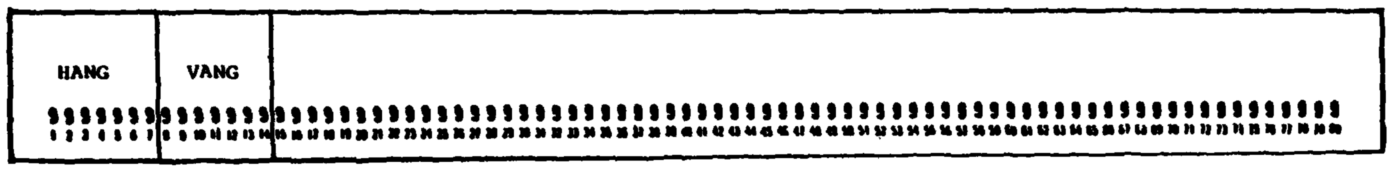
Figure 13. Orienting the Line-of-Sight Using a Target Point.

(see Figure 14a):

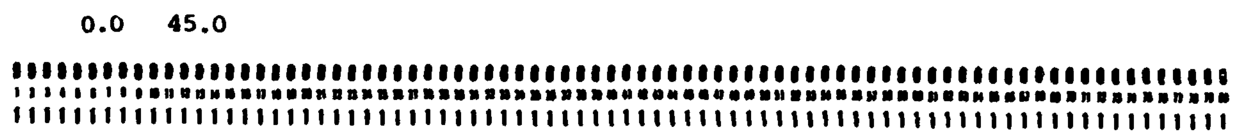
- columns 1-7 the vertical angle (HANG) offset
- columns 8-14 the horizontal angle (VANG) offset.

Figure 14b shows the sample input for HANG=0.0° and VANG=-45.0°. Note that as with the other eye positional input, when no decimal point is entered, the assumed point is between the second and third to the last card columns in each field.

The user can specify the head position by entering either target data or angular offsets, but not both. Which one the user enters depends on the value of TARG in the CNTRL namelist (see Paragraph 4.1).



(a) The Horizontal and Vertical Angle Offsets Format.



(b) An Example of Vertical and Horizontal Angle Offsets Input.

Figure 14. Orienting the Line-of-Sight Using Vertical and Horizontal Angle Offsets.

SECTION 5
JOB CONTROL

VISANS originated as a function of the COMputerized BIo-mechanical MAN-model interactive graphics program. The current version of VISANS creates offline plots on a CALCOMP 1036 three-pen plotter using a CDC CYBER computer at Wright-Patterson Air Force Base, Ohio. The job control cards used for these runs are shown in the deck setup of Figure 15. Plot information is transferred to TAPE7 under system control. This plot tape produces three-color plots on a CALCOMP 1036 drum plotter utilizing a CALCOMP Model 925 controller with a universal tape drive.

If online plots are desired, a dummy subroutine, NEWPEN(I) must be added to the Program Source as shown in Figure 16. The deck setup for online plot runs is shown in Figure 17.

The Visibility Analysis program (VISANS) is written in FORTRAN IV using a CALCOMP based plotting package. It uses the following units for I/O:

Unit 3 - user input, card image format (see Section 4)
Unit 6 - printed output
Unit 7 - Gould plotter output
Unit 9 - Scratch file used by the program.

```
VIS,T25,IØ50,CM105000.   ID#
FTN.
ATTACH,CCPLØT,CCPLØT1036,ID=LIBRARY,SN=ASD.
LABEL,TAPE7,W,D=PE,VSN=Tape#,RING.
LDSET,LIB=CCPLØT.
LGØ.
7/8/9  (EØF)
.
.        Source Deck
.
7/8/9  (EØF)
.
.        Input Data
.
6/7/8/9  (EØJ)
```

Figure 15. Deck Layout for Offline Plot Runs.

```
SUBROUTINE NEWPEN(I)
RETURN
END
```

Figure 16. Dummy Subroutine NEWPEN.

```
VIS,T25,IØ50,CM105000.   ID#
FTN.
ATTACH,CCPLØT,CCPLØT56X,ID=LIBRARY,SN=ASD.
LIBRARY,CCPLØT.
LGØ.
RØUTE,PLØT,TID=Terminal ID,DC=PT,ST=System designation.
7/8/9  (EØF)
.
.    Source Deck
.
7/8/9  (EØF)
.
.    Input Data
.
6/7/8/9  (EØJ)
```

Figure 17. Deck Layout for Online Plot Run.

APPENDIX A
COMPUTATION OF THE VISION ANGLES

As mentioned in Section 1, crew stations are defined geometrically as panels and contours. These panels and contours are represented by closed polygons, and are input to the program in a user defined coordinate system.

Before calculating the vision angles the user defined coordinate system is transformed through the following steps:

(1) Convert to the three dimensional coordinate system with

$+x$ = forward

$+y$ = left

$+z$ = up

and seat reference point = (0,0,0).

(2) Translate the origin to the eye location of the crew-member.

(3) Then, if the crewmembers head is pointed HANG degrees left of forward and VANG degrees above horizontal

a) rotate HANG degrees left about the z-axis and

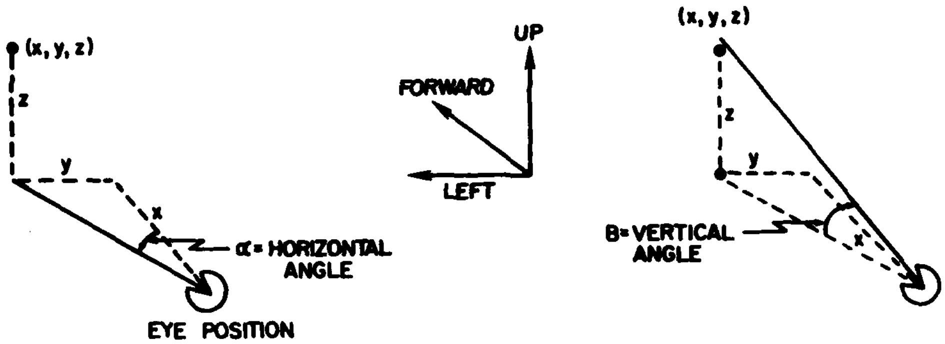
b) rotate VANG degrees up about the y-axis.

Angles are calculated in this resulting coordinate system as follows:

If the coordinates of the point are (x, y, z), then

horizontal angle $\alpha = \tan^{-1}(y/x)$

vertical angle $\beta = \sin^{-1}(z/\sqrt{x^2+y^2+z^2})$



For the program's visibility plot, these angles are sampled at one inch intervals along the polygon perimeters. To save plotting time and storage, each polygon side is tested to see if it is perpendicular to the x-y plane; and if true, the segment is not sampled (because it will show up as a straight line on the plot). For the printed output the angles are calculated only at the polygon vertices.

APPENDIX B
VISIBILITY ANALYSIS PROGRAM LISTINGS

```
      PROGRAM VISANS (INPUT,OUTPUT,TAPE3=INPUT,TAPE6=OUTPUT,TAPE7,TAPE9)
C ******************************************************************
C *   CBMVIS -- GENERATES VISIBILITY PLOTS USING THREE DIMENSIONAL   *
C *                EYE POSITION, AND CREWSTATION COORDINATES         *
C ******************************************************************
C *                                                                  *
C *  THE INPUT STREAM IS AS FOLLOWS;                                 *
C *  1. THE NAMELIST CNTRL                                           *
C *   2  IF NEW=1; CREWSTATION DATA(SEE SECTION 3 OF USER'S GUIDE)   *
C *    3. IF EYELOC.NE.0; THE EYE POSITION  (5X,3F10.2)              *
C       4. IF TARG=1; THREE DIMENSIONAL COORDINATES OF A POINT AT    *
C *                 WHICH THE EYE IS LOOKING.  (3F10.2)              *
C *        IF TARG=0; THE VERTICAL AND HORIZONTAL LINE OF SIGHT      *
C *                 ANGLES(IN THAT ORDER) FOR THE EYES(2F7.2)        *
C *      5. AS MANY MORE COPIES OF #'S 1-4 AS NEEDED                 *
C *       6. THE NAMELIST CNTRL WITH IEND=1                          *
C *                                                                  *
C ******************************************************************
C *                                                                  *
C *  THE NAMELIST CNTRL'S VARIABLES;                                 *
C *  NEW.....IF NEW=1 READ IN VISIBILITY DATA FROM UNIT 3            *
C *                 THE DATA IS REFORMATTED AND WRITTEN TO UNIT 9    *
C *                 FOR USE BY THE PROGRAM.                          *
C *          IF NEW=0 THE PROGRAM ASSUMES DATA IS ALREADY PRESENT ON *
C *                 UNIT 9 IN THE PROPER FORMAT AND BYPASSES THE     *
C *                 CALL TO VISVDM.  THIS IS THE CASE AFTER THE      *
C *                 FIRST PLOT WHEN MORE THAN ONE PLOT IS BEING MADE*
C *                 OF A PARTICULAR CREWSTATION. (DEFAULT:NEW=0)     *
C *  TARG....IF TARG=1  ENTER AN (X,Y,Z) COORDINATE TRIPLET OF THE   *
C *                   POINT AT WHICH THE EYE IS LOOKING.             *
C *          IF TARG=0  ENTER THE VERTICAL AND HORIZONTAL OFFSETS FOR *
C *                   THE LINE OF SIGHT OF THE EYE, IN DEGREES,      *
C *                   WITH RESPECT TO STRAIGHT AHEAD. (DEF:TARG=0)   *
C *  IEND    IEND=1 SIGNALS THE END OF THE DATA. (DEFAULT:IEND=0)    *
C *  EYELOC..EYELOC=0  USE THE X, Y, AND Z COORDINATES OF THE EYE    *
C *          FROM THE PREVIOUS PLOT, IF THIS IS NOT THE FIRST PLOT,  *
C *           OR (0.0,0 0,0 0) IF IT IS THE FIRST PLOT               *
C *          EYELOC=1 READ THE EYE COORDINATES FOR THIS PLOT.        *
C *           (DEF: EYELOC=1)                                        *
C *  ILIM....IF ILIM=0  NO VISUAL FIELD LIMITS ARE PLOTTED           *
C *          IF ILIM=1  VISUAL FIELD LIMITS ARE PLOTTED (DEF:ILIM=1) *
C *                                                                  *
C ******************************************************************
C
      COMMON /VISADC/ IPG,ILN,DATE(2)
      COMMON /VSPT/ ILIM,HANG,VANG,XLEYE,YLEYE,ZLEYE,
     # INAME(2),NEQPTS
      COMMON /AXES/ IX1,IX2,IY1,IY2,IZ1,IZ2,SEAT(3)
      DIMENSION LNAME(60,6)
      REAL ACXYZ(3,20),FXYZ(3,20),ALPH(3000),BETA(3000)
      REAL MHX,MHY,MHZ,BXYZ(3,20),A(3)
      INTEGER VERA(20),HEPA(20)
      INTEGER NAME(6),BNO
      INTEGER TARG,EYELOC
      NAMELIST/CNTRL/ NEW,EYELOC,TARG,ILIM,IEND
      RADANG=57 2957/951
      XLEYE=6.07
```

```
      YLEYE=0.
      ZLEYE=31.5
C   INITIALIZE PLOTS
      CALL PLOTS(0.,0.,7)
      CALL PLOT(4.,-2.,-3)
      CALL PLOT(.05,0.,3)
      CALL PLOT(.05,11.,2)
      CALL VISTPG
C
   10 CONTINUE
      NEW=0
      EYELOC=1
      TARG=0
      ILIM=1
      IEND=0
      HANG=0.
C
      READ (3,CNTRL)
      WRITE(6,CNTRL)
      IF(IEND.EQ.1)GO TO 465
C ********************************************************************
C *        READ IN CREWSTATION COORDINATES                           *
C ********************************************************************
      IF(NEW.EQ.1)CALL VISVDM
C ********************************************************************
C *        READ IN COORDINATES OF THE DESIGN EYE  AS FOLLOWS---      *
C *               ORIGIN AT SEAT REFERENCE POINT(SRP)                *
C *                    +X FORWARD OF SRP                             *
C *                    +Y TO LEFT OF SRP                             *
C *                    +Z UP FROM SRP                                *
C ********************************************************************
      IF(EYELOC.EQ.0)  GO TO 5
      READ(3,1002)     XLEYE,YLEYE,ZLEYE
    5 CONTINUE
C ********************************************************************
C *        READ IN COORDINATES OF TARGET --SAME COORDINATE SYSTEM    *
C *                       AS CREWSTATION                             *
C ********************************************************************
      IF(TARG.EQ.0)GO TO 15
      READ(3,1002)MHX,MHY,MHZ
C                           CONVERT TO SRP SYSTEM
      A(IX1)=(MHX-SEAT(1))*IX2
      A(IY1)=(MHY-SEAT(2))*IY2
      A(IZ1)=(MHZ-SEAT(3))*IZ2
      A(1)=A(1)-XLEYE
      A(2)=A(2)-YLEYE
      A(3)=A(3)-ZLEYE
C                           IS IT = TO EYE LOCATION
      IF(A(1).NE.0.0.OR.A(2).NE.0.0.OR.A(3).NE.0.0)   GO TO 7
      WRITE(6,1001)
      GO TO 10
C
    7 VANG=ATAN2(A(3),SQRT(A(2)**2+A(1)**2))*RADANG
      RTMP=A(1)**2+A(2)**2
      IF(RTMP.GT .00001)  HANG=ATAN2(A(2),A(1))*RADANG
      GO TO 17
   15 CONTINUE
```

```
C ********************************************************************
C *                  ENTER LINE OF SIGHT ANGLES                       *
C *                      + VANG UP                                    *
C *                      + HANG TO LEFT                               *
C ********************************************************************
      READ(3,1005)HANG,VANG
   17 CONTINUE
C ********************************************************************
C *                READ IN CANOPY COORD IN SRP SYSTEM                *
      READ(9,1003)INAME,NBNDS,NEQPTS,XC,YC,ZC,IX,IY,IZ
      IF(EOF(9).GT.0)  GO TO 995
      NNN=NBNDS+NEQPTS
      CALL VISDPG(0)
      IHA=HANG+.5
      IF(HANG.LT.0.) IHA=HANG-.5
      IVA=VANG+.5
      IF(VANG.LT.0.) IVA=VANG-.5
      WRITE(6,2005) INAME,DATE,XLEYE,YLEYE,ZLEYE,IHA,IVA
      CALL VISDPG(5)
      RBN=3
      DO 450  IJ=1,NNN
      READ(9,1004) BNO,NAME,NOVC,((ACXYZ(L,J),L=1,3),J=1,NOVC)
      IF(EOF(9).GT.0)  GO TO 996
      IF(IJ.LE.NBNDS)  GO TO 50
      DO 40 II=1,6
   40 LNAME(IJ-NBNDS,II)=NAME(II)
   50 CONTINUE
C ********************************************************************
C *          TRANSLATE COORD. FROM SRP SYSTEM TO LEYE SYSTEM         *
C ********************************************************************
      DO 100 I=1,NOVC
      EXYZ(1,I)=ACXYZ(1,I)-XLEYE
      EXYZ(2,I)=ACXYZ(2,I)-YLEYE
      EXYZ(3,I)=ACXYZ(3,I)-ZLEYE
  100 CONTINUE
C ********************************************************************
C *           ROTATE AXES
C ********************************************************************
      CALL ROTATE(EXYZ,NOVC,HANG,VANG)
C ********************************************************************
C *      LOOP THRU XYZ ARRAY AND LOCATE POINTS OF INTERSECTION       *
C ********************************************************************
      NPNTS=0
      DO 300 I=1,NOVC
      IVAR=I+1
      IF(I.EQ.NOVC) IVAR=1
      DELX=EXYZ(1,IVAR)-EXYZ(1,I)
      DELY=EXYZ(2,IVAR)-EXYZ(2,I)
      DELZ=EXYZ(3,IVAR)-EXYZ(3,I)
      VMAG=SQRT(DELX**2+DELY**2+DELZ**2)
      LIM=IFIX(VMAG)+1
C ********************************************************************
C *                  VERTICAL LINE TEST                               *
C ********************************************************************
      IF(VMAG.GT.1.AND.(VMAG-ABS(DELZ)).LE.2.) LIM=2
      IF(VMAG.EQ.0.) VMAG=1.
      DO 250 ICNT=1,LIM
```

```
      DINCR=(ICNT-1)/VMAG                                              001810
      IF(ICNT EQ LIM) DINCR=1.0                                        001820
      X3=EXYZ(1,I)+DINCR*DELX                                          001830
      Y3=-(EXYZ(2,I)+DINCR*DELY)                                       001840
      Z3=EXYZ(3,I)+DINCR*DELZ                                          001850
      TEMP=0.                                                          001860
      RTMP=X3**2+Y3**2                                                 001870
      IF(RTMP.GT..00001) TEMP=(ATAN2(Y3,X3))*RADANG                    001880
      ALPHA=TEMP+180.                                                  001890
      NPNTS=NPNTS+1                                                    001900
      ALPH(NPNTS)=ALPHA                                                001910
      DEN=SQRT(X3**2+Y3**2+Z3**2)                                      001920
C                                 FLAG POINTS THAT LAND ON EYE         001930
      IF(DEN.GT.0.) GO TO 244                                          001940
      ALPHA=1.E9                                                       001950
      BETAT=1.E9                                                       001960
      ALPH(NPNTS)=ALPHA                                                001970
      BETA(NPNTS)=BETAT                                                001980
      GO TO 246                                                        001990
C   VERTICAL ANGLE CALCULATED USING ARCSIN                             002000
  244 CONTINUE                                                         002010
      BETAT=(ASIN(Z3/DEN))*RADANG+90.                                  002020
      BETA(NPNTS)=BETAT                                                002030
  246 CONTINUE                                                         002040
      IF(ICNT.GT.1) GO TO 250                                          002050
      HERA(I)=(180.-ALPHA)+SIGN(.5,180.-ALPHA)                         002060
      VERA(I)=(BETAT-90.)+SIGN(.5,BETAT-90.)                           002070
 250  CONTINUE                                                         002080
 300  CONTINUE                                                         002090
      IF(IJ.EQ.1)  CALL VISPLT                                         002100
C *************************************************************        002110
C *                  PLOT POINTS ALONG CONTOUR                  *      002120
C *************************************************************        002130
      CALL NEWPEN(1)                                                   002140
      IPEN=3                                                           002150
      DO 380 I=1,NPNTS                                                 002160
      XD=ALPH(I)*.04                                                   002170
      YD=BETA(I)*.04                                                   002180
      IF(I.EQ.1)   GO TO 373                                           002190
      AALPH=ABS(ALPH(I)-ALPH(I-1))                                     002200
      AALPH1=(ALPH(I)+ALPH(I-1))/2                                     002210
      BBETA1=(BETA(I)+BETA(I-1))/2                                     002220
      IF(AALPH.GE 35 ) IPEN=3                                          002230
      IF(AALPH1.LT.1. .OR. AALPH1.GT. 359. .OR.                        002240
     *   BBETA1.LT.1. .OR. BBETA1.GT. 179.)  IPEN=3                    002250
  373 IF(IJ GT NBNDS) RBN=RBN+1                                        002260
      IF(XD.LT.0..OR.XD.GT.14.3.OR.YD.LT.0..OR.YD.GT.7.125)  GO TO 379 002270
      IF((XD.LT.2.0.OR.XD.GT.12.3) AND.YD.GT.5.925)  GO TO 379         002280
      IF(IJ.LE.NBNDS) GO TO 375                                        002290
      CALL NUMBER(XD,YD,.150,RBN,0.0,-1)                               002300
      GO TO 380                                                        002310
  375 CALL PLOT(XD,YD,IPEN)                                            002320
      IPEN=2                                                           002330
      GO TO 380                                                        002340
  379 IPEN=3                                                           002350
  380 CONTINUE                                                         002360
C *************************************************************        002370
```

```
      C *                PRINT TAEULAR DATA                              *
      C ******************************************************************
            DO 420 I=1,NOVC
            BXYZ(1,I)=ACXYZ(IX1,I)*IX2+XC
            BXYZ(2,I)=ACXYZ(IY1,I)*IY2+YC
            BXYZ(3,I)=ACXYZ(IZ1,I)*IZ2+ZC
        420 CONTINUE
            IP= NOVC+7
            CALL VISDPG(IP)
            IF(ILN.NE.0)  GO TO 402
            CALL VISDPG(5)
            WRITE(6,2005) INAME,DATE,XLEYE,YLEYE,ZLEYE,IHA,IVA
        402 WRITE(6,2008) NAME,IX,IY,IZ
            DO 450 I=1,NOVC
            WRITE(6,2006) HERA(I),VERA(I),(BXYZ(J,I),J=1,3)
        450 CONTINUE
        460 CONTINUE
            REWIND 9
            CALL PLOT(14.4,0.0,-3)
            IF(NEQPTS.NE.0) CALL LSLGND(NEQPTS,LNAME)
            TSP=3.
            IF(NEQPTS.EQ.0)  TSP=1.
            CALL PLOT(TSP,9.0,3)
            CALL PLOT(TSP,-1.6,-2)
            GO TO 10
      C
        465 CONTINUE
            WRITE (6,2012)
            GO TO 997
        995 WRITE (6,2010)
            GO TO 997
        996 WRITE (6,2011)
        997 CALL PLOTE(AAA)
            STOP
      C ******************************************************************
      C *                          FORMATS                               *
      C ******************************************************************
       1001 FORMAT(///,10X,44H INVALID DATA  .  TARGET LOCATION EQUIVALENT ,
           # 16H TO EYE LOCATION    )
       1002 FORMAT(3F10.2)
       1003 FORMAT(5X,2A4,1X,I2,I2,3F6.2,3(1X,A1),3(1X,A2))
       1004 FORMAT(I3,6A4,I3,/,(4(3F6.2)))
       1005 FORMAT(2F7.2)
       2005 FORMAT(/,38X,23HVISIBILITY MEMBER NAME  ,2A4,2H (,2A4,1H),//38X,
           #      29HEYE LOCATION IN SRP SYSTEM  (  ,2(F6.2,1H,),F6.2,1H),
           #  //39X,24HLINE-OF-SIGHT IN DEGREES,6X,1H( ,I4,2H, ,I4,1H))
       2006 FORMAT(13X,I5,3X,I5,11X,3F10.3 )
       2008 FORMAT(1H-,38X,26HVISIBILITY PLOT DATA FOR  ,2A4,
           # //13X,20HLINE OF SIGHT ANGLES,13X,20HORIGINAL COORDINATES ,
           # /13X,14HHORIZ.   VERT.,16X,A2,8X,A2,8X,A2/)
       2010 FORMAT(53H VIS050A NO VISIBILITY PLOT DATA AVAILABLE ON UNIT 9. )
       2011 FORMAT(31H VIS051A END OF DATA ON UNIT 9.  )
       2012 FORMAT(48H VIS052I VISIBILITY PLOT GENERATED SUCCESSFULLY.  )
            END
```

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PROGRAM VISANS      74/74    OPT=1                         FTN 4.8+528        08/05/81  15.45.00        PAGE     6

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
10273  VISANS         1

VARIABLES       SN  TYPE            RELOCATION
26370  A            REAL       ARRAY              REFS       51      102      103      104    3*106    3*110    2*111
                                                2*112   DEFINED      99      100      101      102      103      104
11553  AAA       *  REAL                          REFS      261
11543  AALPH        REAL                          REFS      214   DEFINED     211
11547  AALPH1       REAL                          REFS    2*215   DEFINED     212
12324  ACXYZ        REAL       ARRAY              REFS       50      146      147      148      232      233      234
                                              DEFINED      136
12111  ALPH         REAL       ARRAY              REFS       50      208    2*211    2*212  DEFINED      182      188
11540  ALPHA        REAL                          REFS      182      188    2*197  DEFINED      180      186
11550  BBETA1       REAL                          REFS    2*215   DEFINED     213
20404  BETA         REAL       ARRAY              REFS       50      209    2*213  DEFINED      189      194
11542  BETAT        REAL                          REFS      189      194    2*198  DEFINED      187      193
11573  BNO          INTEGER                       REFS       53   DEFINED     136
25274  BXYZ         REAL       ARRAY              REFS       51      243  DEFINED      232      233      234
    2  DATE         REAL       ARRAY    VISADC    REFS       45      132      240
11525  DELX         REAL                          REFS      164      174  DEFINED      161
11526  DELY         REAL                          REFS      164      175  DEFINED      162
11527  DELZ         REAL                          REFS      164      169      176  DEFINED      163
11541  DEN          REAL                          REFS      185      193  DEFINED      183
11533  DINCR        REAL                          REFS      174      175      176  DEFINED      172      173
12120  EXYZ         REAL       ARRAY              REFS       50      153    2*161    2*162    2*163      174      175
                                                  176   DEFINED     146      147      148
11475  EYELOC       INTEGER                       REFS       54       55       89  DEFINED       69
    1  HANG         REAL                VSPT      REFS       46      128    2*129      153  DEFINED       73      112
                                                  120
25417  HERA         INTEGER    ARRAY              REFS       52      243  DEFINED      197
11522  I            INTEGER                       REFS    2*146    2*147    2*148      159      160      161      162
                                                  163      174      175      176      197      198      208      209
                                                  210    2*211    2*212    2*213    2*232    2*233    2*234    3*243
                                              DEFINED      145      158      207      231      242
11532  ICNT         INTEGER                       REFS      172      173      196  DEFINED      171
11477  IEND         INTEGER                       REFS       55       77  DEFINED       72
11512  IHA          INTEGER                       REFS      132      240  DEFINED      128      129
11521  II           INTEGER                       REFS    2*140   DEFINED     139
11515  IJ           INTEGER                       REFS      138      140      201      217      220
                                              DEFINED      135
    0  ILIM         INTEGER             VSPT      REFS       46       55  DEFINED       71
    1  ILN          INTEGER             VISADC    REFS       45      238
    6  INAME        INTEGER    ARRAY    VSPT      REFS       46      132      240  DEFINED      124
11551  IP           INTEGER                       REFS      237   DEFINED     236
11543  IPEN         INTEGER                       REFS      223   DEFINED     206      214      215      224      226
    0  IPG          INTEGER             VISADC    REFS       45
11513  IVA          INTEGER                       REFS      132      240  DEFINED      130      131
11524  IVAR         INTEGER                       REFS      161      162      163  DEFINED      159      160
11506  IX           INTEGER                       REFS      241   DEFINED     124
    0  IX1          INTEGER             AXES      REFS       48       99      232
    1  IX2          INTEGER             AXES      REFS       48       99      232
11507  IY           INTEGER                       REFS      241   DEFINED     124
    2  IY1          INTEGER             AXES      REFS       48      100      233
    3  IY2          INTEGER             AXES      REFS       48      100      233
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              PROGRAM VISANS     74/74   OPT=1                     FTN 4.8+528        08/05/81  15.45.00       PAGE      7

VARIABLES      SN  TYPE              RELOCATION
11510  IZ          INTEGER                          REFS        241    DEFINED     124
    4  IZ1         INTEGER               AXES       REFS         48        101     234
    5  IZ2         INTEGER               AXES       REFS         48        101     234
11520  J           INTEGER                          REFS        136        243  DEFINED     136       243
11517  L           INTEGER                          REFS        136    DEFINED     136
11531  LIM         INTEGER                          REFS        171        173  DEFINED     165       169
11554  LNAME       INTEGER      ARRAY               REFS         49        248  DEFINED     140
11470  MHX         REAL                             REFS         51         99  DEFINED      97
11471  MHY         REAL                             REFS         51        100  DEFINED      97
11472  MHZ         REAL                             REFS         51        101  DEFINED      97
25443  NAME        INTEGER      ARRAY               REFS         53        140     241  DEFINED       136
11502  NBNDS       INTEGER                          REFS        126        138     140      217       220
                                                 DEFINED        124
   10  NEOPTS      INTEGER               VSPT       REFS         46        126   2*248      250   DEFINED       124
11476  NEW         INTEGER                          REFS         55         81  DEFINED      68
11511  NNN         INTEGER                          REFS        135    DEFINED     126
11516  NOVC        INTEGER                          REFS        136        145     153      158       160       231       236
                                                     242    DEFINED        136
11523  NPNTS       INTEGER                          REFS        181        182     188      189       194       207
                                                 DEFINED        157        181
11500  RADANG      REAL                             REFS        110        112     179      193   DEFINED        56
11514  RBN         REAL                             REFS        217        221  DEFINED     134       217
11501  RTMP        REAL                             REFS        112        179  DEFINED     111       178
    6  SEAT        REAL         ARRAY    AXES       REFS         48         99     100      101
11474  TARG        INTEGER                          REFS         54         55      96  DEFINED        70
11537  TEMP        REAL                             REFS        180    DEFINED     177      179
11552  TSP         REAL                             REFS        251        252  DEFINED     249       250
    2  VANG        REAL                  VSPT       REFS         46        130   2*131      153   DEFINED       110       128
25373  VERA        INTEGER      ARRAY               REFS         52        243  DEFINED     198
11530  VMAG        REAL                             REFS        165      2*169     170      172   DEFINED       164       170
11503  XC          REAL                             REFS        232    DEFINED     124
11544  XD          REAL                             REFS      2*216      2*219     221      223   DEFINED       208
    3  XLEYE       REAL                  VSPT       REFS         46        102     132      146       240
                                                 DEFINED         57         90
11534  X3          REAL                             REFS        176        179     183  DEFINED       174
11504  YC          REAL                             REFS        233    DEFINED     124
11545  YD          REAL                             REFS      2*213        219     221      223   DEFINED       209
    4  YLEYE       REAL                  VSPT       REFS         45        103     132      147       240
                                                 DEFINED         58         90
11535  Y3          REAL                             REFS        178        179     183  DEFINED       175
11505  ZC          REAL                             REFS        234    DEFINED     124
    5  ZLEYE       REAL                  VSPT       REFS         46        104     132      148       240
                                                 DEFINED         59         90
11535  Z3          REAL                             REFS        183        193  DEFINED     176

FILE NAMES          MODE
    0  INPUT
 2054  OUTPUT
    0  TAPE3        MIXED                 READS        75         90      97     120
 2054  TAPE6        MIXED                 WRITES       76        107     132     240      241       243       256       258
                                            260
 4130  TAPE7
 6204  TAPE9        FMT                   READS       124        136  MOTION     245

EXTERNALS           TYPE    ARGS        REFERENCES
       ASIN         REAL      1 LIBRARY     193
       ATAN2        REAL      2 LIBRARY     110       112        179
```

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           PROGRAM VISANS      74/74    OPT=1                         FTN 4.8+526         08/05/81  15.45.00        PAGE      8

EXTERNALS            TYPE    ARGS         REFERENCES
        EOF         REAL      1             125        137
        LSLGND                2             248
        NEWPEN                1             205
        NUMBER                6             221
        PLOT                  3              62         63          64         223         247         251         252
        PLOTE                 1             261
        PLOTS                 3              61
        ROTATE                4             153
        SQRT        REAL      1 LIBRARY     110        164         183
        VIS3PG                1             127        133         237         239
        VISPLT                0             201
        VISTPG                0              65
        VISVDM                0              81

INLINE FUNCTIONS     TYPE    ARGS          DEF LINE  REFERENCES
        ABS         REAL      1  INTRIN                 159         211
        IFIX        INTEGER   1  INTRIN                 165
        SIGN        REAL      2  INTRIN                 197         198

NAMELISTS           DEF LINE      REFERENCES
        CNTRL           55          75          76

STATEMENT LABELS              DEF LINE    REFERENCES
10332  5                          91          89
10363  7                         110         106
10312  10                         67         108        253
10401  15                        114          96
10403  17                        121         113
    0  40                        140         139
10462  50                        141         136
    0  100                       149         145
10604  244                       192         185
10612  246                       195         190
10642  250                       199         171        196
    0  300                       200         158
10665  373                       217         210
10712  375                       223         220
10716  379                       226         216        219
10717  380                       227         207        222         225
10750  402                       241         230
    0  420                       235         231
    0  450                       244         242
    0  460                       245         135
11023  465                       255          77
11026  995                       258         125
11031  996                       260         137
11033  997                       261         257        259
11310  1001     FMT              266         107
11321  1002     FMT              268          90         97
11323  1003     FMT              269         124
11330  1004     FMT              270         130
11334  1005     FMT              271         120
11336  2003     FMT              272         132        240
11337  2005     FMT              275         243
11363  2006     FMT              276         241
11402  2010     FMT              279         258
11411  2011     FMT              280         260
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          PROGRAM VISANS     74/74   OPT=1                          FTN 4.8+528        08/05/81  15.45.00         PAGE     9

 STATEMENT LABELS              DEF LINE   REFERENCES
 11416  2012     FMT              281        256

 LOOPS  LABEL    INDEX       FROM TO     LENGTH     PROPERTIES
 10-3-  460      IJ           135 245     345B                EXT REFS    EXITS  NOT INNER
 10436  40       II           139 140      3B        INSTACK
 10470  100      I            145 149      6B        INSTACK
 10503  300      I            158 200     127B                EXT REFS  NOT INNER
 10537  250      ICNT         171 199      71B                EXT REFS
 10641  360      I            207 227      61B                EXT REFS
 10736  420      I            231 235      11B          OPT
 10763  450      I            242 244      14B                EXT REFS

 COMMON BLOCKS   LENGTH      MEMBERS   BIAS NAME(LENGTH)
        VISADC        4                 0 IPG      (1)               1 ILN     (1)                2 DATE    (2)
        VSPT          9                 0 ILIM     (1)               1 HANG    (1)                2 VANG    (1)
                                        3 XLEYE    (1)               4 YLEYE   (1)                5 ZLEYE   (1)
                                        6 INAME    (2)               8 NEOPTS  (1)
        AXES          9                 0 IX1      (1)               1 IX2     (1)                2 IY1     (1)
                                        3 IY2      (1)               4 IZ1     (1)                5 IZ2     (1)
                                        6 SEAT     (3)

 STATISTICS
   PROGRAM LENGTH              16557B     7535
   BUFFER LENGTH                7672B     4026
   CM LABELED COMMON LENGTH      26B        22
          52000B CM USED
```

```
      SUBROUTINE VISPLT
      COMMON /VISADC/ IPG,ILN,DATE(2)
      COMMON /VSPT/ ILIM,HANG,VANG,XLEYE,YLEYE,ZLEYE,
     # INAME(2),NEQPTS
      DIMENSION AB(3,4)
      INTEGER ABC(4)
      DIMENSION IHT(3),IHL(3),IVT(3),IVL(3)
      DATA IHT/9HRIGHT OF  ,5HFROM  ,8HLEFT OF  /,IHL/9,5,8/
      DATA IVT/6HBELOW  ,5HFROM  ,6HABOVE  /,IVL/6,5,6/
      DATA AB/165.,66.,-82.,95.,66.,-82.,74.,48.,-56.,56.,48 , 66./
      DATA ABC/1HM,1HP,1HF,1HS/
C
      CALL PLOT(1.,0.,-3)
C *********************************************************************
C *                       PLOT HEADINGS                               *
C *********************************************************************
      AL=17.
      IF(NEQPTS.EQ.0)  AL=AL-2.
      CALL SYMBOL(.2,2.8,.3,16HVERTICAL DEGREES,90.,16)
      CALL SYMBOL( 5,3 3,.2,18HFROM LINE-OF-SIGHT,90.,18)
      TSP=(AL-9.5)/2.+.6
      CALL SYMBOL(TSP,9.8,.5,19HVISIBILITY ANALYSIS ,0.,19)
      TSP=(AL-4 2)/2 + 6
      CALL SYMBOL(TSP,9.4,.2,13HCREWSTATION: ,0.,13)
      CALL SYMBOL(999.,999.,.2,INAME(1),0.,4)
      CALL SYMBOL(999.,999.,.2,INAME(2),0.,4)
      TSP=(AL- 11.1)/2 + 6
      CALL SYMBOL(TSP,.4,.3,37HHORIZONTAL DEGREES FROM LINE-OF-SIGHT,
     # 0.,37)
C *********************************************************************
C *                    OUTLINE AREA OF PLOT                           *
C *********************************************************************
      CALL PLOT(1.2,1.5,3)
      CALL PLOT(1.2,8.8,2)
      CALL PLOT(15.6,8.8,2)
      CALL PLOT(15.6,1.6,2)
      CALL PLOT(1.1,1.6,2)
C *********************************************************************
C *                    DRAW HORIZONTAL GRID                           *
C *********************************************************************
      CALL NEWPEN(2)
      XC=15.6
      XD=1.1
      YC=1.6
      DO 320 I=1,17,2
      YC=YC+.4
      CALL PLOT(XD,YC,3)
      CALL PLOT(XC,YC,2)
      IF(I.EQ.17) GO TO 320
      IF(I.EQ.15)XC=13.6
      IF(I.EQ.15)XD=3.2
      YC=YC+.4
      CALL PLOT(XC,YC,3)
      CALL PLOT(XD,YC,2)
  320 CONTINUE
C *********************************************************************
C *                    DRAW VERTICAL GRID                             *
```

```
C *****************************************************************
      XC=1.2
      YC=7.6
      DO 340 I=1,35,2
      XC=XC+.4
      IF(I.EQ.5)YC=8.8
      CALL PLOT(XC,1.5,3)
      CALL PLOT(XC,YC,2)
      IF(I.EQ.35) GO TO 340
      XC=XC+.4
      IF(I.EQ.31)YC=7.6
      CALL PLOT(XC,YC,3)
      CALL PLOT(XC,1.5,2)
  340 CONTINUE
C *****************************************************************
C *                  PUT A LEGEND ON THE PLOT                     *
C *****************************************************************
      CALL NEWPEN(1)
      H=.075
      X=13.8
      CALL SYMBOL(13.75,8.6,.1,13HVISION LIMITS,0.,13)
      CALL SYMBOL(X,8.29,H,23HS - STEREO                ,0.,23)
      CALL SYMBOL(X,8.11,H,23HF - FIXATION              ,0.,23)
      CALL SYMBOL(X,7.93,H,23HP - PERIPHERAL            ,0.,23)
      CALL SYMBOL(X,7.75,H,23HM - MAXIMUM PERIPHERAL    ,0.,23)
      CALL SYMBOL(1.5,8.55,.1,12HEYE LOCATION,0.,12)
      CALL SYMBOL(1.75,8.40,.075,4HX = ,0.,4)
      CALL NUMBER(2.05,8.40,.075,XLEYE,0.,2)
      CALL SYMBOL(1.75,8.25,.075,4HY = ,0.,4)
      CALL NUMBER(2.05,8.25,.075,YLEYE,0.,2)
      CALL SYMBOL(1.75,8.10,.075,4HZ = ,0.,4)
      CALL NUMBER(2.05,8.10,.075,ZLEYE,0.,2)
      CALL SYMBOL(1.6,7.8,.075,5HDATE:,0.,5)
      CALL SYMBOL(999.,999.,.075,1H ,0.,1)
      CALL SYMBOL(999.,999.,.075,DATE(1),0.,4)
      CALL SYMBOL(999.,999.,.075,DATE(2),0.,4)
C *****************************************************************
C *                     LABEL VERTICAL AXIS                       *
C *****************************************************************
      YC=1.5
      IY=90
  345 DO 350 I=1,7
      XC=.35
      YP=IABS(IY)
      IF (YP.LT.10) XC=XC+.15
      CALL NUMBER(XC,YC,.15, YP,0.,-1)
      CALL SYMBOL(999.,YC+.075,.1,1H0,0.,1)
      YC=YC+1.2
      IF (YC.GT.8.7) GO TO 353
      IY=IY-30
  350 CONTINUE
  353 XC=1.3
      IX=210
      DO 360 I=1,13
      YC=.9
      IX=IX-30
      XP=IABS(IX)
```

```
      IF (XP.LT.100) YC=YC+.15                                              004060
      IF (XP.LT.10) YC=YC+.15                                               004070
      CALL NUMBER(XC,YC,.15,XP,90.,-1)                                      004080
      CALL SYMBOL(XC-.075,999.,.1,1H0,90.,1)                                004090
      XC=XC+1.2                                                             004100
  340 CONTINUE                                                              004110
C ******************************************************************       004120
C *                  PRINT ORIENTATION OF MODEL                     *       004130
C ******************************************************************       004140
      HA=HANG                                                               004150
      IF(HANG) 331,332,333                                                  004160
  331 IHS=1                                                                 004170
      HA=-HA                                                                004180
      GO TO 335                                                             004190
  332 IHS=2                                                                 004200
      GO TO 335                                                             004210
  333 IHS=3                                                                 004220
  335 VA=VANG                                                               004230
      IF(VANG) 336,337,338                                                  004240
  336 IVS=1                                                                 004250
      VA=-VA                                                                004260
      GO TO 339                                                             004270
  337 IVS=2                                                                 004280
      GO TO 339                                                             004290
  338 IVS=3                                                                 004300
  339 ITL=58+IHL(IHS)+IVL(IVS)                                              004310
      IF(HA.LT.10.)  ITL=ITL-1                                              004320
      IF(VA.LT.10.)  ITL=ITL-1                                              004330
      TSP=(AL-(ITL*.2))/2.+.6                                               004340
      CALL SYMBOL(TSP,9.,.2,30HCREWMEMBER'S HEAD IS POINTING  ,0.,30)       004350
      CALL NUMBER(999.,999.,.2,HA  ,0.,-1)                                  004360
      CALL SYMBOL(999.,9.12,.12,2H0 ,0.,2)                                  004370
      CALL SYMBOL(999.,9.,.2,IHT(IHS),0.,IHL(IHS) )                         004380
      CALL SYMBOL(999.,9.,.2,12HFORWARD AND  ,0.,12 )                       004390
      CALL NUMBER (999.,999.,.2,VA  ,0.,-1)                                 004400
      CALL SYMBOL(999.,9.12,.12,2H0 ,0.,2)                                  004410
      CALL SYMBOL(999.,9.,.2,IVT(IVS),0.,IVL(IVS) )                         004420
      CALL SYMBOL(999.,9.,.2,10HHORIZONTAL ,0.,10 )                         004430
C ******************************************************************       004440
C *                    LABEL HORIZONTAL AXIS                        *       004450
C *            RESET ORIGIN OF PLOT TO LL CORNER OF GRID            *       004460
C ******************************************************************       004470
      CALL PLOT(1.2,1.5,-3)                                                 004480
C   PLOT FORWARD SYMBOL                                                     004490
      CALL NEWPEN(3)                                                        004500
      Y1=0.0                                                                004510
      CALL SYMBOL(7.2,Y1+3.5,.15,1,0.,-1)                                   004520
C ******************************************************************       004530
C *                    GENERATE VISION LIMITS                       *       004540
C ******************************************************************       004550
      IF(ILIM.EQ.0) RETURN                                                  004560
      DO 355 I=1,4                                                          004570
      A=A3(1,I)                                                             004580
      LIMX=IFIX(A)+1                                                        004590
      DO 353 K=1,2                                                          004600
      X1=-A                                                                 004610
      DO 353 J=1,LIMX                                                       004620
```

```
            SQ1=SQRT(1.-(X1/A)**2)                                         004630
            X11=(X1+180.)*.04-.04375                                       004640
            IF(K.EQ.2) GO TO 362                                           004650
            Y1=AB(2,I)*SQ1                                                 004660
            Y11=(Y1+90 )*.04                                               004670
            IF(J.EQ.2) CALL PLOT(X11,Y11,3)                                004680
            IF(J.GT.2.AND.J.LT.LIMX) CALL PLOT(X11,Y11,2)                  004690
            IF(J EQ 1 OR.J.EQ.LIMX)                                        004700
           # CALL SYMBOL(X11,Y11,.0675,ABC(I),0.,1)                        004710
            GO TO 364                                                      004720
        362 CONTINUE                                                       004730
            Y2=AB(3,I)*SQ1                                                 004740
            Y21=(Y2+90.)*.04                                               004750
            IF(J.EQ.2) CALL PLOT(X11,Y21,3)                                004760
            IF(J.GT.2.AND.J.LT.LIMX)CALL PLOT(X11,Y21,2)                   004770
        364 CONTINUE                                                       004780
            X1=X1+2.                                                       004790
        363 CONTINUE                                                       004800
        365 CONTINUE                                                       004810
            RETURN                                                         004820
            END                                                            004830
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS      DEF LINE      REFERENCES
   1  VISPLT          1          165        191

VARIABLES      SN  TYPE              RELOCATION
  1354  A          REAL                              REFS      168     170     172  DEFINED     167
  1366  AB         REAL       ARRAY                  REFS        5     167     175      183  DEFINED     10
  1402  ABC        INTEGER    ARRAY                  REFS        6     179  DEFINED      11
  1332  AL         REAL                              REFS       18      21      23       27     143
                                                  DEFINED       17      18
     2  DATI       REAL       ARRAY     VISADC       REFS        2      92      93
  1340  H          REAL                              REFS       79      80      81       82  DEFINED     76
  1346  HA         REAL                              REFS      127     141     145  DEFINED     124     127
     1  HANG       REAL                 VSPT         REFS        3     124     125
  1337  I          INTEGER                           REFS       49      50      51       63      66     68     167
                                                     175       179     183  DEFINED       45      61     99     111
                                                     166
  1411  IHL        INTEGER    ARRAY                  REFS        7     140     147  DEFINED       8
  1347  IHS        INTEGER                           REFS      140   2*147  DEFINED      126     129    131
  1406  IHT        INTEGER    ARRAY                  REFS        7     147  DEFINED        8
     0  ILIM       INTEGER              VSPT         REFS        3     165
     1  ILN        INTEGER              VISADC       REFS        2
     5  INAME      INTEGER    ARRAY     VSPT         REFS        3      25      26
     0  IPG        INTEGER              VISADC       REFS        2
  1352  ITL        INTEGER                           REFS      141     142     143  DEFINED     140     141    142
  1417  IVL        INTEGER    ARRAY                  REFS        7     140     151  DEFINED       9
  1351  IVS        INTEGER                           REFS      140   2*151  DEFINED      134     137    139
  1414  IVT        INTEGER    ARRAY                  REFS        7     151  DEFINED        9
  134   IX         INTEGER                           REFS      113     114  DEFINED      110     113
  1342  IY         INTEGER                           REFS      101     107  DEFINED       98     107
```

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        SUBROUTINE VISPLT      74/74   OPT=1                              FTN 4.8+528        08/05/81  15 45 00       PAGE     5

 VARIABLES      SN  TYPE              RELOCATION
  1360  J           INTEGER                        REFS       177      2*178     2*179      185      2*186
                                                 DEFINED      171
  1356  K           INTEGER                        REFS       174    DEFINED      169
  1355  LIMX        INTEGER                        REFS       171      178        179      186     DEFINED      168
    10  NEQPTS      INTEGER            VSPT        REFS         3       18
  1361  SQ1         REAL                           REFS       175      183     DEFINED     172
  1333  TSP         REAL                           REFS        22       24         28      144     DEFINED       21        23
                                                    27        143
  1350  VA          REAL                           REFS       135      142        149    DEFINED      132      135
     2  VANG        REAL               VSPT        REFS         3      132        133
  1341  X           REAL                           REFS        79       80         81       82     DEFINED       77
  1334  XC          REAL                           REFS        48       53         62       64        65       67        69
                                                    70        102      103        117      118       119
                                                 DEFINED       42       50         59       62        67      100       102
                                                   109        119
  1337  XD          REAL                           REFS        47       54     DEFINED      43        51
     3  XLEYE       REAL               VSPT        REFS         3       85
  1347  XP          REAL                           REFS       115      116        117    DEFINED      114
  1357  X1          REAL                           REFS       172      173        188    DEFINED      170      188
  1362  X11         REAL                           REFS       177      178        179      185       186
                                                 DEFINED      173
  1336  YC          REAL                           REFS        46       47         48       52        53       54        65
                                                    69        103      104        105      106       115      116       117
                                                 DEFINED       44       46         52       60        63       68        97
                                                   105        112      115        116
     4  YLEYE       REAL               VSPT        REFS         3       87
  1343  YP          REAL                           REFS       102      103     DEFINED     101
  1353  Y1          REAL                           REFS       161      176     DEFINED     160       175
  1363  Y11         REAL                           REFS       177      178        179    DEFINED      176
  1364  Y2          REAL                           REFS       184    DEFINED      183
  1365  Y21         REAL                           REFS       185      186     DEFINED     184
     5  ZLEYE       REAL               VSPT        REFS         3       89

 EXTERNALS             TYPE    ARGS         REFERENCES
          NEWPEN                 1             41        75       159
          NUMBER                 6             85        87        89      103       117       145       149
          PLOT                   3             13        33        34       35        36        37        47       48        53
                                               51        64        65       69        70       157       177      178       185
                                              186
          SQRT.        REAL      1 LIBRARY    172
          SYMBOL                 6             19        20        22       24        25        26        28       78        79
                                               80        81        82       83        84        86        88       90        91
                                               92        93       104      118       144       146       147      148       150
                                              151       152       161      179

 INLINE FUNCTIONS      TYPE    ARGS        DEF LINE  REFERENCES
          IABS         INTEGER   1  INTRIN             101       114
          IFIX         INTEGER   1  INTRIN             168

 STATEMENT LABELS                    DEF LINE    REFERENCES
   111    320                           55          45        49
     0    331        INACTIVE          126         125
   303    332                          129         125
   305    333                          131         125
   306    335                          132         126       130
     0    336        INACTIVE          134         133
   313    337                          137         133
```

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      SUBROUTINE VISPLT      74/74   OPT=1                            FTN 4.8+528         08/05/81  15.45.00         PAGE     6

STATEMENT LABELS               DEF LINE   REFERENCES
  315  338                        139        133
  316  339                        140        136       138
  143  340                         71         61        66
    0  345         INACTIVE        99
    0  350                        108         99
  243  353                        109        106
    0  360                        120        111
  451  362                        182        174
    0  363                        189        169       171
  467  364                        187        181
    0  365                        190        166

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
   64  320      I           45 55      30B              EXT REFS
  117  340      I           61 71      27B              EXT REFS
  215  350      I           99 108     26B              EXT REFS    EXITS
  247  360      I          111 120     27B              EXT REFS
  402  365      I          166 190     77B              EXT REFS  NOT INNER
  407  363      K          169 189     67B              EXT REFS  NOT INNER
  412  363      J          171 189     62B              EXT REFS

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
       VISADC        4             0 IPG     (1)                1 ILN     (1)                 2 DATE    (2)
       VSPT          9             0 ILIM    (1)                1 HANG    (1)                 2 VANG    (1)
                                   3 XLEYE   (1)                4 YLEYE   (1)                 5 ZLEYE   (1)
                                   6 INAME   (2)                8 NEQPTS  (1)

STATISTICS
  PROGRAM LENGTH                 1524B      852
  CM LABELED COMMON LENGTH        15B       13
          52000B CM USED
```

```
            SUBROUTINE VISVDM                                                004840
      C ******************************************************************  004850
      C *           CBMVDM - VISIBILITY DATABASE MAINTENANCE               *  004860
      C *                                                                  *  004870
      C ******************************************************************  004880
            COMMON /VISADC/ IPG,ILN,DATE(2)                                  004890
            COMMON /AXES/ IX1,IX2,IY1,IY2,IZ1,IZ2,ACXYZ(3)                   004900
            INTEGER ITYP(6),BNV,NAME(2),ITYPE(6)                             004910
            INTEGER BNO(100) ,BNAME(6,100)                                   004920
            REAL  BX(25),BY(25),EZ(25),BXYZ(3,25,100)                        004930
            DATA IADD/4H&ADD/                                                004940
            DATA ITYP/1HF,1HA,1HL,1HR,1HU,1HD/                               004950
            DATA ITYPE   /1,-1,2,-2,3,-3/,BLANK/4H                           004960
            DATA BXYZ/7500*0./                                               004970
            IPG=0                                                            004980
            JCHK=0                                                           004990
      C ******************************************************************  005000
      C *                     COMMAND PROCESSOR                            *  005010
      C ******************************************************************  005020
         10 READ(3,1000) IOPR,NAME,NBNDS,NEQPTS,ACXYZ,IX,IY,IZ,DATE          005030
            CALL VISDPG(0)                                                   005040
            IF(IOPR.EQ.IADD) GO TO 20                                        005050
      C   ** ERROR **  1ST CARD IS NOT AN 'ADD' CARD                         005060
            WRITE(6,1001) IOPR,NAME,NBNDS,NEQPTS,ACXYZ,IX,IY,IZ              005070
            WRITE(6,2000) IOPR                                               005080
            GO TO 710                                                        005090
      C ******************************************************************  005100
      C *                ADD CREW STATION DATA MEMBER                      *  005110
      C ******************************************************************  005120
         20 CONTINUE                                                         005130
            CALL VISDPG(1)                                                   005140
      C   PRINT THE 1ST INPUT CARD AS READ IN                                005150
            WRITE(5,1001) IOPR,NAME,NBNDS,NEQPTS,ACXYZ,IX,IY,IZ              005160
            IF(NAME(1).NE.BLANK.OR.NAME(2).NE.BLANK) GO TO 22                005170
            CALL VISDPG(1)                                                   005180
            WRITE(5,2005) IOPR                                               005190
            GO TO 10                                                         005200
        22  NNN=NBNDS+NEQPTS                                                 005210
            IF(NNN.GE.1.AND.NNN.LE.100.AND.NEQPTS.LE.40) GO TO 25            005220
      C   ** ERROR **  TOTAL NUMBER OF BOUNDARIES AND MISC EQUIP TOO LARGE   005230
            CALL VISDPG(1)                                                   005240
            WRITE(6,2007) NAME                                               005250
            GO TO 10                                                         005260
         25 DO 30 I=1,6                                                      005270
            IF(IX.EQ.ITYP(I)) GO TO 40                                       005280
         30 CONTINUE                                                         005290
      C   ** ERROR **  ILLEGAL X-AXIS QUALIFIER                              005300
            CALL VISDPG(1)                                                   005310
            WRITE(6,2008) IX,NAME                                            005320
            GO TO 10                                                         005330
         40 IX1=IABS(ITYPE(I))                                               005340
            IX2=ISIGN(1,ITYPE(I))                                            005350
            DO 50 I=1,6                                                      005360
            IF(IY.EQ.ITYP(I)) GO TO 60                                       005370
         50 CONTINUE                                                         005380
      C   ** ERROR ** ILLEGAL Y-AXIS QUALIFIER                               005390
            CALL VISDPG(1)                                                   005400
```

```
      WRITE(6,2009) IY,NAME
      GO TO 10
   60 IY1=IABS(ITYPE(I))
      IY2=ISIGN(1,ITYPE(I))
      DO 70 I=1,6
      IF(IZ.EQ.ITYP(I)) GO TO 80
   70 CONTINUE
C    ** ERROR ** ILLEGAL Z-AXIS QUALIFIER
      CALL VISDPG(1)
      WRITE(6,2010) IZ,NAMF
      GO TO 10
   80 IZ1=IABS(ITYPE(I))
      IZ2=ISIGN(1,ITYPE(I))
      IF(IX1.NE.IY1.AND.IX1.NE.IZ1.AND.IY1.NE.IZ1) GO TO 95
C    ** ERROR **  COLINEAR AXES
      CALL VISDPG(1)
      WRITE(6,2011) NAME
      GO TO 10
   95 CONTINUE
      CALL VISDPG(4)
      WRITE(6,2019) NAME,DATE,NBNDS,NEQPTS,ACXYZ,IX,IY,IZ
      WRITE(9,2012) NAME,NBNDS,NEQPTS,ACXYZ,IX,IY,IZ
C    PROCESSOR BOUNDARY DEFINED
      DO 110 I=1,NNN
      READ(3,1002) BNO(I),(BNAME(J,I),J=1,6),BNV,
     #  (BX(J),BY(J),BZ(J),J=1,BNV)
      K=I-1
      DO 93 J=1,K
      IF(I.NE.1.AND.BNO(J).EQ.BNO(I)) GO TO 94
   93 CONTINUE
      GO TO 99
   94 CALL VISDPG(1)
      WRITE(6,2025) (BNAME(L,I),L=1,6),(BNAME(L,J),L=1,6)
      JCHK=JCHK+1
   99 DO 100 J=1,BNV
      BXYZ(IX1,J,I)=(BX(J)- ACXYZ(1))*IX2
      BXYZ(IY1,J,I)=(BY(J)- ACXYZ(2))*IY2
  100 BXYZ(IZ1,J,I)=(BZ(J)- ACXYZ(3))*IZ2
      CALL VISDPG(1)
       WRITE(6,1003) BNO(I),(BNAME(J,I),J=1,6),BNV
      DO 107 J=1,BNV
      CALL VISDPG(1)
  107 WRITE(6,1004) (BX(J),BY(J),BZ(J),(BXYZ(K,J,I),K=1,3))
      IF(JCHK.EQ.0) WRITE(9,2013 ) BNO(I),(BNAME(J,I),J=1,6),BNV,
     #((BXYZ(K,J,I),K=1,3),J=1,BNV)
  110 CONTINUE
      IF(JCHK.NE.0)  GO TO 170
C    PROCESSING COMPLETED SUCCESSFULLY
      WRITE(6,2026) NAME,NBNDS,NEQPTS
      REWIND 9
      RETURN
C
C    ERROR ENCOUNTERED DURING PROCESSING
  170 WRITE(6,2029) NAME,JCHK
      GO TO 710
C
C
```

```
      C   END                                                            005980
      C                                                                  005990
  710 WRITE(6,2099)                                                      006000
      STOP                                                               006010
      C                                                                  006020
      C ***************************************************************  006030
      C *                        FORMATS                              *  006040
      C ***************************************************************  006050
 1000 FORMAT(A4,1X,2A4,I3,I2,3F6.2,3(1X,A1),8X,2A4 )                     006060
 1001 FORMAT(9H VIS500I ,A4,1X,2A4,I3,I2,3F6.2,3(1X,A1),3(1X,A2))        006070
 1002 FORMAT(I3,6A4,2X,I3/(3(F6.2)))                                     006080
 1003 FORMAT(I15,3H.) ,6A4,2X,I2,19H VERTICES --INPUT C,                 006090
     #       42HOORDINATES -          ABSOLUTE COORDINATES--)            006100
 1004 FORMAT(58X,1H(,3F7.2,8H)  TO  (,3F7.2,1H))                         006110
      C                                                                  006120
 2000 FORMAT(9H VIS501A ,A4,19H UNKNOWN OPERATION.)                      006130
 2005 FORMAT(24H VIS505A NO NAME GIVEN, ,A4,10H, IGNORED.)               006140
 2007 FORMAT(56H VIS507A NUMBER OF BOUNDARIES OR EQUIPMENTS INVALID FOR  006150
     # 7H MEMBER ,2A4,1H. )                                              006160
 2008 FORMAT(9H VIS508A ,A1,26H FOR X INVALID, MEMBER IS ,2A4,1H.)       006170
 2009 FORMAT(9H VIS509A ,A1,26H FOR Y INVALID, MEMBER IS ,2A4,1H.)       006180
 2010 FORMAT(9H VIS510A ,A1,26H FOR Z INVALID, MEMBER IS ,2A4,1H.)       006190
 2011 FORMAT(49H VIS511A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER ,2A4)   006200
 2012 FORMAT(5X,2A4,1X,I2,I2,3F6.2,3(1X,A1))                             006210
 2013 FORMAT(I3,6A4,I3,/,(4(3F6.2)))                                     006220
 2019 FORMAT(17H VIS519I MEMBER, ,2A4,2H (,2A4,1H),5H, HAS,I4,           006230
     # 15H BOUNDARIES AND,I3,24H MISCELANEOUS EQUIPMENTS /               006240
     #         38H VIS520I COORDINATES ARE TRANSLATED TO,                006250
     #         2H (,F7.2,1H,,F7.2,1H,,F7 2,2H)./22H VIS521I COORDINATES G 006260
     #         8HIVEN AS ,A1,2H, ,A1,5H AND ,A1,21H ARE NOW F, L, AND U.) 006270
 2025 FORMAT(9H VIS531A ,6A4,20H HAS SAME NUMBER AS ,6A4,1H.)            006280
 2028 FORMAT(9H VIS534I ,2A4,5H WITH,I5,15H BOUNDARIES AND,I3,           006290
     # 40H MISCELANEOUS EQUIPMENTS HAS BEEN ADDED.  )                    006300
 2029 FORMAT(9H VIS535A ,2A4,17H NOT ADDED DUE TO,I5,10H ERROR(S).)      006310
 2099 FORMAT(21H VIS522I PROGRAM END.)                                   006320
      END                                                                006330
```

```
SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   1  VISVDM         1           108

VARIABLES       SN  TYPE            RELOCATION
    6  ACXYZ        REAL        ARRAY    AXES      REFS      7      24     33     78      79      93    94
                                                     95   DEFINED    20
  345  BLANK        REAL                           REFS    2*3?  DEFINED   13
 1177  BNAME        INTEGER     ARRAY              REFS      9    2*90     97    101   DEFINED    82
 1033  BNO          INTEGER     ARRAY              REFS      9    2*86     97    101   DEFINED    82
 1000  BNV          INTEGER                        REFS      8      82     92     97      99   2*101
                                                DEFINED     82
 2327  BX           REAL        ARRAY              REFS     10      93    100  DEFINED    82
 2?42  BXYZ         REAL        ARRAY              REFS     10     100    101  DEFINED    14      93    94
                                                     95
```

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        SUBROUTINE VISVDM      74/74   OPT=1                         FTN 4.8+528       08/05/81  15.45.00       PAGE    4

VA-IABLES      SN  TYPE          RELOCATION
  2360  BY         REAL      ARRAY                REFS        10        94       100    DEFINED      82
  2411  BZ         REAL      ARRAY                REFS        10        95       100    DEFINED      82
     2  DATE       REAL      ARRAY     VISADC     REFS         6        78   DEFINED         20
  1011  I          INTEGER                        REFS        45        51        52         54        60        61        63
                                                    69        70      2*82        84       2*86        90        93        94
                                                    95      2*97       100     3*101    DEFINED        44        53        62
                                                    81
   3..  IADD       INTEGER                        REFS        22   DEFINED        11
     1  ILN        INTEGER             VISADC     REFS         6
  1002  IOPR       INTEGER                        REFS        22        24        25         33        36
                                               DEFINED        20
     0  IPG        INTEGER             VISADC     REFS         6   DEFINED        15
  101.  ITYP       INTEGER   ARRAY                REFS         8        45        54         63   DEFINED        12
  1025  ITYPE      INTEGER   ARRAY                REFS         8        51        52         60        61        69        70
                                               DEFINED        13
  100.  IX         INTEGER                        REFS        24        33        45         49        78        79
                                               DEFINED        20
     0  IX1        INTEGER             AXES       REFS         7      2*71        93    DEFINED        51
     1  IX2        INTEGER             AXES       REFS         7        93   DEFINED         52
  1006  IY         INTEGER                        REFS        24        33        54         58        78        79
                                               DEFINED        20
     2  IY1        INTEGER             AXES       REFS         7      2*71        94    DEFINED        60
     3  IY2        INTEGER             AXES       REFS         7        94   DEFINED         61
  1007  IZ         INTEGER                        REFS        24        33        63         67        78        79
                                               DEFINED        20
     4  IZ1        INTEGER             AXES       REFS         7      2*71        95    DEFINED        69
     5  IZ2        INTEGER             AXES       REFS         7        95   DEFINED         70
  1012  J          INTEGER                        REFS      4*82        86        90       2*93      2*94      2*95        97
                                                 4*100     2*101   DEFINED      2*82         85        92        97        98
                                                 2*101
  1001  JCHK       INTEGER                        REFS        91       101       104        111   DEFINED        16        91
  1013  K          INTEGER                        REFS        85       100       101    DEFINED        84       100       101
  1014  L          INTEGER                        REFS      2*90   DEFINED      2*90
  1023  NAME       INTEGER   ARRAY                REFS         8        24        33       2*34        42        49        58
                                                    67        74        78         79       106       111
                                               DEFINED        20
  1003  NBNDS      INTEGER                        REFS        24        33        38         78        79       106
                                               DEFINED        20
  1004  NEQPTS     INTEGER                        REFS        24        33        38         39        78        79       106
                                               DEFINED        20
  1010  NNN        INTEGER                        REFS      2*39        81   DEFINED         38

FILE NAMES       MODE
       TAPE3     FMT                   READS        20        82
       TAPE6     FMT                  WRITES        24        25        33        36         42        49        58        67
                                          74        78        90        97       100        106       111       117
       TAPE9     FMT                  WRITES        79       101    MOTION       107

EXTERNALS         TYPE   ARGS        REFERENCES
       VISDPG              1              21        31        35        41        48         57        66        73        77
                                          89        96        99

INLINE FUNCTIONS    TYPE   ARGS         DEF LINE  REFERENCES
       IABS       INTEGER    1  INTRIN              51        60        69
       ISIGN      INTEGER    2  INTRIN              52        61        70
```

```
      SUBROUTINE VISVDM      74/74   OPT=1                          FTN 4.8+528        08/05/81  15.45.00        PAGE     5

STATEMENT LABELS                   DEF LINE   REFERENCES
    4  10                              20       37        43        50        59        68        75
   17  20                              30       22
   35  22                              38       34
   50  25                              44       39
    0  30                              46       44
   62  40                              51       45
    0  50                              55       53
  100  60                              60       54
    0  70                              64       62
  116  80                              69       63
    0  93                              87       85
  201  94                              89       86
  134  95                              76       71
  216  99                              92       88
    0  100                             95       92
    0  107                            100       96
    0  110                            103       81
  325  170                            111      104
  330  710                            117       26       112
  561  1000     FMT                   123       20
  566  1001     FMT                   124       24        33
  574  1002     FMT                   125       82
  600  1003     FMT                   126       97
  612  1004     FMT                   128      100
  617  2000     FMT                   130       25
  624  2005     FMT                   131       36
  632  2007     FMT                   132       42
  643  2008     FMT                   134       49
  652  2009     FMT                   135       56
  661  2010     FMT                   136       67
  670  2011     FMT                   137       74
  677  2012     FMT                   138       79
  703  2013     FMT                   139      101
  707  2013     FMT                   140       76
  741  2025     FMT                   145       90
  747  2023     FMT                   146      106
  762  2029     FMT                   148      111
  771  2093     FMT                   149      117

LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
   51  30       I          44  46         5B       INSTACK    EXITS
   67  50       I          53  55         5B       INSTACK    EXITS
  105  70       I          62  64         5B       INSTACK    EXITS
  143  110      I          81 103       156B                 EXT REFS  NOT INNER
  154           J          82  82        11B                 EXT REFS
  171  93       J          85  87        10B          OPT     EXITS
  234  100      J          92  95        11B          OPT
  260  107      J          98 100        21B                 EXT REFS

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
       VISADC        4             0 IPG      (1)            1 ILN     (1)            2 DATE    (2)
       AXES          9             0 IX1      (1)            1 IX2     (1)            2 IY1     (1)
                                   3 IY2      (1)            4 IZ1     (1)            5 IZ2     (1)
                                   6 ACXYZ    (3)
```

```
STATISTICS
  PROGRAM LENGTH                21156B    8814
  CM LABELED COMMON LENGTH        15B       13
         32000B CM USED
```

```
  1           SUBROUTINE VISDPG (I)                                                006340
        C ******************************************************************** 006350
        C *     VISDPG - VISIBILITY DATA BASE MAINTENANCE PAGE CONTROL       *  006360
        C *                                                                  *  006370
  5     C *      PARAMETERS                                                  *  006380
        C *           I - NUMBER OF LINES TO BE PRINTED, IF 0 THEN DO EJECT *  006390
        C *                                                                  *  006400
        C *      COMMON VARIABLES SET -                                      *  006410
        C *           IPG - PAGE COUNTER                                     *  006420
 10     C *           ILN - LINE COUNTER                                     *  006430
        C ******************************************************************** 006440
        C                                                                      006450
              COMMON /VISADC/ IPG,ILN,DATE(2)                                  006460
        C                                                                      006470
 15           IF(I.EQ.0.OR.I+ILN.GT.58) GO TO 100                              006480
              ILN=ILN+I                                                        006490
              GO TO 200                                                        006500
        C                                                                      006510
         100  ILN=I                                                            006520
 20           IPG=IPG+1                                                        006530
              WRITE(6,1001) IPG                                                006540
          200 RETURN                                                           006550
        C ******************************************************************** 006560
        C *                          FORMATS                                 *  006570
 25     C ******************************************************************** 006580
         1001 FORMAT(38H1VISANS -- VISIBILITY ANALYSIS PROGRAM ,55X,6H  PAGE,  006590
             # I4 // )                                                         006600
              END                                                              006610
```

```
     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
    3  VISDPG         1          22

VARIABLES     SN  TYPE           RELOCATION
    2  DATE       REAL      ARRAY   VISADC     REFS     13
    0  I          INTEGER            F.P.      REFS     2*15     16     19   DEFINED    1
    1  ILN        INTEGER           VISADC     REFS     13       15     16   DEFINED   15     19
    0  IPG        INTEGER           VISADC     REFS     13       20     21   DEFINED   20

FILE NAMES       MODE
       TAPE6     FMT                 WRITES      21

STATEMENT LABELS             DEF LINE   REFERENCES
   12  100                      19         15
   17  200                      22         17
   24  1001     FMT             26         21

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
       VISADC       4            0 IPG    (1)              1 ILN    (1)              2 DATE   (2)
```

```
      SUBROUTINE VISDPG     74/74    OPT=1                          FTN 4.8+528        08/05/81  15.45.00        PAGE     2

 STATISTICS
   PROGRAM LENGTH                338        27
   CM LABELED COMMON LENGTH       4B         4
          52000B CM USED
```

```
SUBROUTINE LSLGND      74/74    OPT=1                          FTN 4.8+523        08/05/81  15.45.00        PAGE     1

  1              SUBROUTINE LSLGND(NEQPTS,LNAME)                                        006620
           C *******************************************************************   006630
           C *    LSLGND PLOTS THE LEGEND FOR THIS CREWSTATION                     *   006640
           C *******************************************************************   006650
  5              DIMENSION LNAME(50,6)                                                  006660
                 CALL PLOT(0 0,7 2,2)                                                   006670
                 CALL PLOT(2.0,7.2,2)                                                   006680
                 CALL PLOT(2.0,0.0,2)                                                   006690
                 CALL PLOT(0 0,0 0,2)                                                   006700
 10              H=.075                                                                 006710
                 CALL SYMBOL(.5,7.0,.1,6HLEGEND ,0.,6 )                                 006720
                 X=.3                                                                   006730
                 Y=6.925                                                                006740
                 DO 85 I=1,NEQPTS                                                       006750
 15              Y=Y-.15                                                                006760
                 R=I                                                                    006770
                 CALL NUMBER(.075,Y,H,R,0.,0)                                           006780
                 CALL SYMBOL(X,Y,H,LNAME(I,1),0.,4)                                     006790
                 DO 10 J=2,6                                                            006800
 20           10 CALL SYMBOL(999.,999.,H,LNAME(I,J),0.,4)                               006810
              85 CONTINUE                                                               006820
                 RETURN                                                                 006830
                 END                                                                    006840


     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   3  LSLGND          1           22

VARIABLES     SN  TYPE            RELOCATION
  143  H          REAL                              REFS       17       18       20   DEFINED     10
  146  I          INTEGER                           REFS       16       18       20   DEFINED     14
  150  J          INTEGER                           REFS       20   DEFINED      19
    0  LNAME      INTEGER     ARRAY     F.P.        REFS        5       18       20   DEFINED      1
    0  NEQPTS     INTEGER               F.P.        REFS       14   DEFINED       1
  147  R          REAL                              REFS       17   DEFINED      16
  144  X          REAL                              REFS       18   DEFINED      12
  145  Y          REAL                              REFS       15       17       19   DEFINED     13      15

EXTERNALS          TYPE   ARGS        REFERENCES
     NUMBER                 6            17
     PLOT                   3             6       7       8       9
     SYMBOL                 6            11      18      20

STATEMENT LABELS              DEF LINE   REFERENCES
    0  10                        20          19
    0  85                        21          14

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
   25   85       I          14 21      23B              EXT REFS  NOT INNER
   36   10       J          19 20      10B              EXT REFS
```

```
STATISTICS
  PROGRAM LENGTH             157B     111
      52000B CM USED
```

```
SUBROUTINE VISTPG     74/74   OPT=1                       FTN 4.8+528        08/05/81  15.45.00       PAGE      1

              SUBROUTINE VISTPG                                                           006850
        C ***************************************************************************** 006860
        C *                       VISTPG PRINTS A TITLE PAGE                            * 006870
        C ***************************************************************************** 006880
              WRITE(6,1000)                                                               006890
              WRITE(6,1001)                                                               006900
              WRITE(6,1002)                                                               006910
              RETURN                                                                      006920
        C                                                                                 006930
         1000 FORMAT (1HS)                                                                006940
         1001 FORMAT(23H1 A COMPUTER PROGRAM OF/                                          006950
             132H     THE UNITED STATES AIR FORCE/                                        006960
             242H     AEROSPACE MEDICAL RESEARCH LABORATORY/                              006970
             342H     WRIGHT-PATTERSON AIR FORCE BASE, OHIO/                              006980
             415H            ...../                                                       006990
             556H            THE ELECTRICAL & COMPUTER ENGINEERING DIVISION/              007000
             649H            UNIVERSITY OF DAYTON RESEARCH INSTITUTE/                     007010
             723H            DAYTON , OHIO)                                               007020
         1002 FORMAT ( 15(/),                                                             007030
             1 60X,14H--  VISANS  -- ,///,48X,30HCREWMEMBER VISIBILITY ANALYSIS,007040
             2 8H PROGRAM    )                                                            007050
        C                                                                                 007060
              END                                                                         007070


      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    1  VISTPG         1            8

FILE NAMES         MODE
       TAPE6       FMT                  WRITES        5         6         7

STATEMENT LABELS               DEF LINE    REFERENCES
   22  1000     FMT               10          5
   24  1001     FMT               11          6
   65  1002     FMT               19          7

STATISTICS
  PROGRAM LENGTH                  76B       62
          320008 CM USED
```

```
SUBROUTINE ROTATE     74/74   OPT=1                         FTN 4.8+528       08/05/81  15.45.00       PAGE    1

            SUBROUTINE ROTATE(A,N,HANG,VANG)
      C
      C           THIS SUBROUTINE ROTATES THE AXES
      C             THROUGH A HORIZONTAL ANGLE
      C             OF HANG DEGREES AND A VERTICAL
      C             ANGLE OF VANG DEGREES
            DIMENSION A(3,20),B(3,20)
            RADANG=57.29577951
      C
      C
            HCOS=COS(HANG/RADANG)
            HSIN=SIN(HANG/RADANG)
      C
      C              HORIZONTAL ROTATION
      C
            DO 100 I=1,N
            B(1,I)= HCOS*A(1,I)  + HSIN*A(2,I)
            B(2,I)=-HSIN*A(1,I)  + HCOS*A(2,I)
            B(3,I)=                                 A(3,I)
        100 CONTINUE
      C
            VCOS=COS(VANG/RADANG)
            VSIN=SIN(VANG/RADANG)
      C
      C              VERTICAL ROTATION
      C
            DO 200 I=1,N
            A(1,I)= VCOS*B(1,I)               + VSIN*B(3,I)
            A(2,I)=                   B(2,I)
            A(3,I)=-VSIN*B(1,I)               + VCOS*B(3,I)
        200 CONTINUE
      C
            RETURN
            END


   SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   3  ROTATE          1            33

VARIABLES      SN  TYPE            RELOCATION
    0  A            REAL         ARRAY    F.P.      REFS        7       2*17      2*18       19     DEFINED       1        28
                                                       29      30
   66  B            REAL         ARRAY              REFS        7       2*28        29      2*30    DEFINED      17        18
                                                       19
    0  HANG         REAL                  F.P.      REFS       11         12     DEFINED      1
   61  HCOS         REAL                            REFS       17         18     DEFINED     11
   62  HSIN         REAL                            REFS       17         18     DEFINED     12
   63  I            INTEGER                         REFS     3*17       3*18      2*19     3*28       2*29      3*30
                                                 DEFINED       16         27
    0  N            INTEGER               F.P.      REFS       16         27     DEFINED      1
   60  RADANG       REAL                            REFS       11         12        22       23     DEFINED       8
    0  VANG         REAL                  F.P.      REFS       22         23     DEFINED      1
```

```
     SUBROUTINE ROTATE       74/74   OPT=1                                FTN 4.8+528        08/05/81  15.45.00        PAGE      2

VARIABLES      SN  TYPE            RELOCATION
   64   VCOS       REAL                             REFS         28          30   DEFINED        22
   65   VSIN       REAL                             REFS         28          30   DEFINED        23

EXTERNALS          TYPE    ARGS        REFERENCES
        COS        REAL      1 LIBRARY      11          22
        SIN        REAL      1 LIBRARY      12          23

STATEMENT LABELS                DEF LINE    REFERENCES
     0  100                        20          16
     0  200                        31          27

LOOPS  LABEL     INDEX       FROM-TO     LENGTH     PROPERTIES
   23  100        I            16 20        6B       INSTACK
   47  200        I            27 31        6B       INSTACK

STATISTICS
  PROGRAM LENGTH                  1628      114
         520008 CM USED
```

```
  CSB    NOS/BE L530C        L530C-CMR3 R N 09.21
15.44.28.PMG928K  FROM     /92
15.44.28.IP   0000012. WORDS - FILE INPUT   , DC 04
15.44.28.PMG,T10,IO1. .  L710461  POTTER
15.44.30.ATTACH,FILE,VISPROG,MR=1.
15.44.30.AT CY= 052 SN=AMRL
15.45.00.FTN,I=FILE,R=3.
15.45.58      3.601 CP SECONDS COMPILATION TIME
15.45.58.OP  0001260. WORDS - FILE OUTPUT , DC 40
15.45.58.MS    14592  WORDS  (    32832 MAX USED)
15.45.58.CPA       3.862 SEC         1.933 ADJ.
15.45.58.IO       13.798 SEC.        7.810 ADJ.
15.45.58.CM      332.338 KWS.        2.703 ADJ.
15.45.58.CRUS                       12.447
15.45.58.COST                $         .56
15.45.58.PP       16.860 SEC.     DATE 06/05/81
15.45.58.EJ  END OF JOB, 92  L710461.

                   PMG928K //// END OF LIST ////
```

REFERENCES

Bapu, P. et al., "User's Guide for COMBIMAN Programs. Version 4", AFAMRL-TR-80-91 (AD A-097705) January 1981.

MIL-STD-850A, "Aircrew Station Vision Requirements for Military Aircraft" June 1967.

MIL-STD-1333, "Aircrew Station Geometry for Military Aircraft" June 1969.

Kennedy, K. W. and D. McKechnie, "Visibility Toward the Ground from Selected Tactical Aircraft", AMRL-TR-69-123 (AD 880934), Oct 70.

Edwards, T. M., "Development of an Instrument for Measuring Aircraft Cockpit Visibility Limits", Technical Development Report No. 153, Civil Aeronautics Administration and Evaluation Center, Indianapolis, Indiana, January 1952.

*U.S.Government Printing Office: 1982 — 559-007/6036